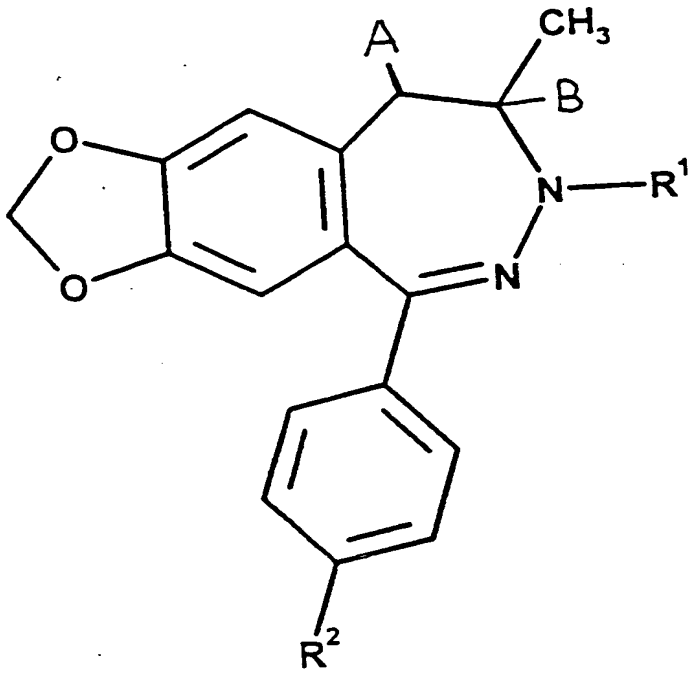
1,3-DIOXOLO/4,5-H//2,3/BENZODIAZEPINE DERIVATIVES AS AMPA/KAINATE RECEPTOR INHIBITORS

Novel 1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives, a pharmaceutical composition containing the same, and a process for the preparation of the active ingredient

The invention refers to novel 1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives, a pharmaceutical composition containing the same, and a process for the preparation of the active ingredient.

More specifically, the invention refers to novel 1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives of the formula I



I

wherein

A represents a hydrogen atom,

B means a hydrogen atom,

R^1 stands for a group of the formula $-(CH_2)_n-CO-(CH_2)_m-R$, wherein

R represents a halo atom, a pyridyl group or a group of the formula $-NR^3R^4$, wherein

R^3 and R^4 mean, independently, a hydrogen atom, a C_{3-6} cycloalkyl group, a C_{1-4} alkoxy group, an amino group, a phenyl group optionally substituted by one or two C_{1-4} alkyl group(s), a C_{1-4} alkyl group which latter is optionally substituted by a phenyl group or a saturated heterocyclic group having 5 or 6 members and comprising 1 to 3 nitrogen atom(s) or a nitrogen atom and an oxygen atom as the heteroatom, and said heterocyclic group is optionally substituted by a phenyl group which latter is optionally substituted by 1 to 3 substituent(s), wherein the substituent consists of a C_{1-4} alkoxy group, or

R^3 and R^4 form, with the adjacent nitrogen atom and optionally with a further nitrogen atom or an oxygen atom, a saturated or unsaturated heterocyclic group having 5 or 6 members, being optionally substituted by a phenyl group that is optionally substituted by 1 to 3 substituents, wherein the

substituent is a C_{1-4} alkoxy group,

n has a value of 0, 1 or 2,

m has a value of 0, 1 or 2, or

A forms together with B a valence bond between the carbon atoms in positions 8 and 9, and in this case

R^1 represents a group of the formula $-CO-(CH_2)_p-R^6$, wherein

R^6 stands for a halo atom, a phenoxy group, a C_{1-4} alkoxy group or a group of the formula $-NR^7R^8$, wherein

R^7 and R^8 mean, independently, a hydrogen atom, a guanyl group, a C_{3-6} cycloalkyl group or a C_{1-4} alkyl group which latter is optionally substituted by a phenyl group or a saturated heterocyclic group having 5 or 6 members and comprising one or more nitrogen atom(s) or a nitrogen and an oxygen atom as the heteroatom, wherein the phenyl group is optionally substituted by 1 to 3 identical or different substituent(s), wherein the substituent is a C_{1-4} alkoxy group, or

R^7 and R^8 form together with the adjacent nitrogen atom an oxopyrrolidinyl group, a phthalimido group which latter is optionally substituted, or a saturated heterocyclic group having 5 or 6 members and comprising one or more nitrogen atom(s) or a

nitrogen and an oxygen atom as the heteroatom, and said heterocyclic group is optionally substituted by 1 to 3 identical or different substituent(s) selected from the group consisting of a hydroxy group, a phenyl group, a phenoxy group, a phenyl(C_{1-4} alkyl) group or a phenoxy(C_{1-4} alkyl) group, wherein in case of the substituents listed the phenyl or phenoxy group is optionally substituted by 1 to 3 identical or different substituent(s), wherein the substituent is a halo atom or a C_{1-4} alkoxy group, and, in case of the phenoxy(C_{1-4} alkyl) group, the alkyl group is optionally substituted by 1 or 2 hydroxy group(s),

p has a value of 0, 1 or 2,

R^2 stands for a nitro group, an amino group or a (C_{1-4} alkanoyl)amino group,

and pharmaceutically suitable acid addition salts thereof.

Several 2,3-benzodiazepine derivatives having biological activity are known.

Tofisopam i.e. 1-(3,4-dimethoxyphenyl)--5-ethyl-7,8-dimethoxy-4-methyl-5H-2,3--benzodiazepine having anxiolytic effect is known from HU-P No. 155 572 and GB-P No. 1 202 579, respectively. The known compound does not comprise the ring system 1,3-dioxolo-

/4,5-h//2,3/benzodiazepine.

From HU-P No. 186 760, 7,8-dihydro-8--methyl-9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives having effect on the central nervous system are known, among others. The known compounds are prepared by reducing the corresponding 8-methyl-9H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine derivative.

Various substituted 8-methyl-9H-1,3--dioxolo/4,5-h//2,3/benzodiazepine derivatives are known from HU-P No. 191 698 and the corresponding GB-P No. 2 162 184. The known compounds have antiaggressive and anxiolytic activities.

A novel process for the preparation of partly new 8-methyl-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine derivatives having antiaggressive activity is known from HU-P No. 191 702. According to the novel process, the suitably substituted 2-acetonyl-4,5--methylenedioxybenzophenone is reacted with an excess of hydrazine hydrate.

Further 7,8-dihydro-8-methyl-9H-1,3--dioxolo/4,5-h//2,3/benzodiazepine derivatives having antidepressant and antiparkinsonian activities are known from HU-P No. 206 719.

Some of the 2,3-benzodiazepine derivatives elicit their effect through the non-competitive inhibition of the AMPA/kainate receptors /Donevan, S.D. et al., J. Pharmacol. Exp. Ther., 271, 25-29 (1994)/.

From the literature it is known that

AMPA/kainate receptors play an important role in the acute and chronic diseases of the central nervous system. Through the inhibition of these receptors, muscle relaxant, neuroprotective and anticonvulsive effects can be achieved /Vizi, E.S. et al., CNS Drug Reviews, 2, 91-126 (1996); Lees, G.L., CNS Drugs, 5, 51-74 (1996)/.

The aim of the invention is to prepare novel 2,3-benzodiazepine derivatives that are more effective and less toxic, respectively, than the known 2,3-benzodiazepine derivatives.

It was found that the above aim is achieved by the novel 1,3-dioxolo/4,5-h//2,3/-benzodiazepine derivatives which have - due to their non-competitive AMPA/kainate effect - considerable muscle relaxant, neuroprotective and anticonvulsive activities. Thus, the novel compounds can be employed for the treatment of any diseases (such as epilepsy, diseases resulting in muscle spasm, various neurodegenerative diseases. stroke,) in which the inhibition of the AMPA/kainate receptors is favourable.

In the description and Claims, in the definition of the substituents, under a halo atom primarily a fluoro, chloro, bromo or iodo atom, preferably a fluoro or a chloro atom is meant.

A C_{1-4} alkyl group is a methyl, ethyl, n-propyl, isopropyl, n-butyl, sec.-butyl,

tert.-butyl or isobutyl group. Preferably, a C_{1-4} alkyl group is a methyl, an ethyl or an isopropyl group.

A C_{1-4} alkoxy group is, primarily, a methoxy, ethoxy, n-propoxy, isopropoxy or n-butoxy group, preferably a methoxy group.

A C_{1-4} alkanoyl group is, primarily, a formyl, acetyl or n-propionyl group. Preferably, a C_{1-4} alkanoyl group is an acetyl or a propionyl group.

A C_{3-6} cycloalkyl group is a cyclopropyl, cyclobutyl, cyclopentyl or cyclohexyl group, preferably a cyclopropyl group.

A saturated heterocyclic group having 5 or 6 members and comprising 1 to 3 nitrogen atom(s) or a nitrogen atom and an oxygen atom as the heteroatom is preferably a pyrrolidinyl, piperidinyl, piperazinyl, imidazolyl, triazolyl or morpholino group.

Suitably, the other nitrogen atom of the piperazinyl group is substituted.

In the definition of R^3 and R^4, wherein, together with the adjacent nitrogen atom, they form a saturated or unsaturated heterocyclic group having 5 or 6 members, said group is a heterocyclic group that comprises one or two nitrogen atom(s) or a nitrogen atom and an oxygen atom as the heteroatom, and the heterocyclic ring contains no double bond or it contains one or more double bond(s). The nitrogen atom or one of the nitrogen atoms of the heterocyclic group

is attached to the carbonyl group in the definition of R^1. Such a heterocyclic group is, for example, a pyrrolidinyl, piperidinyl, pyridyl, morpholino, piperazinyl etc. group. Preferably, the above heterocyclic group is a pirrolidinyl, pyridinyl, morpholino or piperazinyl group. Especially preferably, said heterocyclic group is a piperazinyl group. Suitably, the other nitrogen atom of the piperazinyl group is substituted.

Under a pharmaceutically suitable acid addition salt an acid addition salt formed with a pharmaceutically suitable inorganic acid such as hydrochloric acid, hydrobromic acid, sulfuric acid, phosphoric acid etc. or with a pharmaceutically suitable organic acid such as formic acid, acetic acid, fumaric acid, maleic acid, lactic acid, malic acid, tartaric acid, succinic acid, citric acid, methanesulfonic acid etc. is meant.

The invention includes any isomers of the compounds of the formula I and the mixtures thereof.

Under the isomers of the compounds of the formula I - due to the presence of at least one chiral centre - both enantiomers, and - because of isomerisms that exist in case of certain substitutions - the isomers E and Z, diastereomers, tautomeric forms, and the mixtures thereof such as the racemate are meant.

A preferred subgroup of the compounds

of the formula I consists of the 7,8-dihydro--8-methyl-9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives and pharmaceutically suitable acid addition salts thereof, wherein

A represents a hydrogen atom,

B means a hydrogen atom,

R^1 stands for a group of the formula $-(CH_2)_n-CO-(CH_2)_m-R$, wherein

R represents a chloro atom, a pyridyl group or a group of the formula $-NR^3R^4$, wherein

R^3 and R^4 mean, independently, a hydrogen atom, a cyclopropyl group, a C_{1-4} alkoxy group, an amino group, a phenyl group optionally substituted by one or two methyl group(s) or a C_{1-4} alkyl group which latter is optionally substituted by a phenyl group or a saturated heterocyclic group having 5 or 6 members and comprising 1 to 3 nitrogen atom(s) or a nitrogen atom and an oxygen atom as the heteroatom, and the heterocyclic group is optionally substituted by a phenyl group which latter is optionally substituted by 1 to 3 methoxy groups, or

R^3 and R^4 form, with the adjacent nitrogen atom and optionally with a further nitrogen atom or an oxygen atom, a saturated or unsaturated heterocyclic group having 5 or 6 members, being optionally substituted by a phenyl group

that is optionally substituted by 1 to 3 methoxy groups, n has a value of 0, 1 or 2,

m has a value of 0, 1 or 2,

R^2 stands for a nitro group or an amino group.

Within the above subgroup, suitable 7,8--dihydro-8-methyl-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine derivatives are the following compounds of the formula I, wherein

R^3 and R^4 represent, independently, a hydrogen atom, a cyclopropyl group, a methoxy group, an amino group, a dimethylaminophenyl group or a C_{1-2} alkyl group which latter is substituted by a phenyl, morpholino or piperazinyl group, wherein the piperazinyl group is substituted by a methoxyphenyl group, or

R^3 and R^4 form, together with the adjacent nitrogen atom and optionally a further nitrogen atom or oxygen atom, an imidazolyl, morpholino or piperazinyl group, wherein the piperazinyl group is substituted by a methoxyphenyl group,

n has a value of 0 or 1,

m has a value of 0 or 1,

R^2 stands for a nitro group or an amino group,

A represents a hydrogen atom,

B means a hydrogen atom,

and pharmaceutically suitable acid addition salts thereof.

The especially preferred 7,8-dihydro--8-methyl-9H-1,3-dioxolo/4,5-h//2,3/benzo-

diazepine derivatives are the following compounds of the formula I, wherein

R^3 represents a hydrogen atom,

R^4 stands for a cyclopropyl group, a methoxy group or an amino group,

n has a value of 0,

m has a value of 0,

R^2 means an amino group,

A represents a hydrogen atom,

B means a hydrogen atom,

and pharmaceutically suitable acid addition salts thereof.

Another preferred subgroup of the compounds of the invention consists of the 8-methyl-7H-1,3-dioxolo/4,5-h//2,3/benzo-diazepine derivatives of the formula I, wherein

A forms together with B a valence bond between the carbon atoms in positions 8 and 9,

R^1 represents a group of the formula $-CO-(CH_2)_p-R^6$, wherein

R^6 stands for a halo atom, a phenoxy group, a C_{1-4} alkoxy group or a group of the formula $-NR^7R^8$, wherein

R^7 and R^8 mean, independently, a hydrogen atom, a guanyl group or a C_{1-4} alkyl group which latter is optionally substituted by a phenyl group or a morpholino group, wherein the phenyl group is optionally substituted by one or two C_{1-2} alkoxy group(s), or

R^7 and R^8 form together with the adjacent nitrogen atom an oxopyrrolidinyl group, a phthalimido group or a saturated heterocyclic group having 5 or 6 members and comprising one or two nitrogen atom(s) or a nitrogen and an oxygen atom as the heteroatom, and said heterocyclic group is optionally substituted by 1 to 2 identical or different substituent(s) selected from the group consisting of a hydroxy group, a phenyl group, a phenoxy group, a phenyl(C_{1-4} alkyl) group or a phenoxy(C_{1-4} alkyl) group, wherein in case of the substituents listed the phenyl or phenoxy group is optionally substituted by a halo atom or a C_{1-4} alkoxy group,

p has a value of 0, 1 or 2,

R^2 stands for a nitro group or an amino group,

and pharmaceutically suitable acid addition salts thereof.

Within the latter subgroup, suitable 8-methyl-7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives are the following compounds of the formula I, wherein

A forms together with B a valence bond between the carbon atoms in positions 8 and 9,

R^2 represents a nitro group or an amino group,

R^1 stands for a group of the formula

$-CO-(CH_2)_p-R^6$, wherein

R^6 means a chloro atom, a phenoxy group, or a group of the formula $-NR^7R^8$, wherein

R^7 and R^8 represent, independently, a hydrogen atom, a guamyl group or a C_{1-3} alkyl group optionally substituted by a phenyl group, a dimethoxyphenyl group or a morpholino group, or

R^7 and R^8 form with the adjacent nitrogen atom an oxopyrrolidinyl group, a phthalimido group or a saturated heterocyclic group having 5 or 6 members and comprising one or two nitrogen atom(s) or a nitrogen and an oxygen atom as the heteroatom, and said heterocyclic group is optionally substituted by one or two identical or different substituent(s) selected from the group consisting of a hydroxy group, a methoxyphenyl group, a fluorophenyl group, a benzyl group or a (methoxyphenoxy)-(hydroxypropyl) group,

p has a value of 0, 1 or 2,

and pharmaceutically suitable acid addition salts thereof.

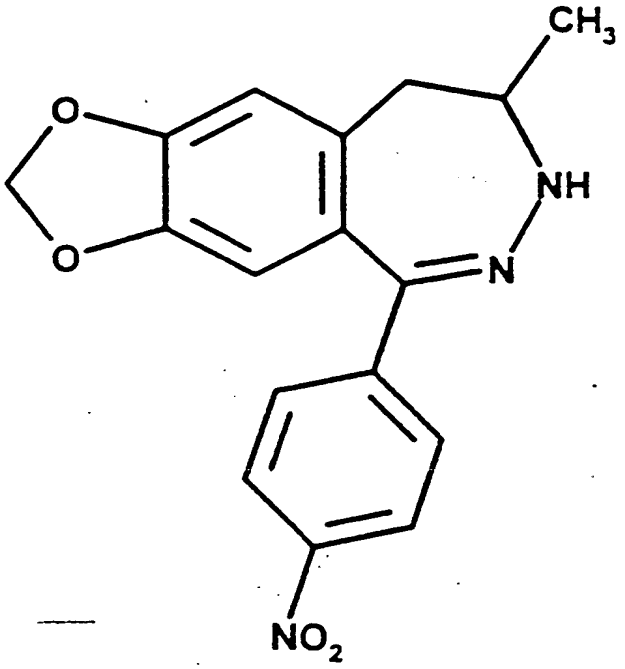
Within the latter subgroup, especially preferred 8-methyl-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine derivatives are the following compounds of the formula I, wherein

R^2 represents an amino group,

R^1, A and B are as defined in connection with the latter subgroup, and pharmaceutically suitable acid addition salts thereof.

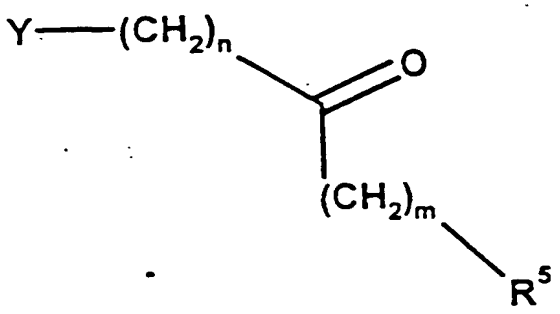
The 1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives of the formula I are prepared as follows:

a) for the preparation of a compound of the formula I, wherein R^1 represents a group of the formula $-(CH_2)_n-CO-(CH_2)_m-R$, wherein R stands for a halo atom or a pyridyl group, n has a value of 0, 1 or 2, m has a value of 0, 1 or 2, R^2 means a nitro group, A and B represent a hydrogen atom, the 7,8-dihydro-8-methyl-5-(4-nitrophenyl)-9H--1,3-dioxolo/4,5-h//2,3/benzodiazepine of the formula III



III

is reacted with a reagent of the formula VI



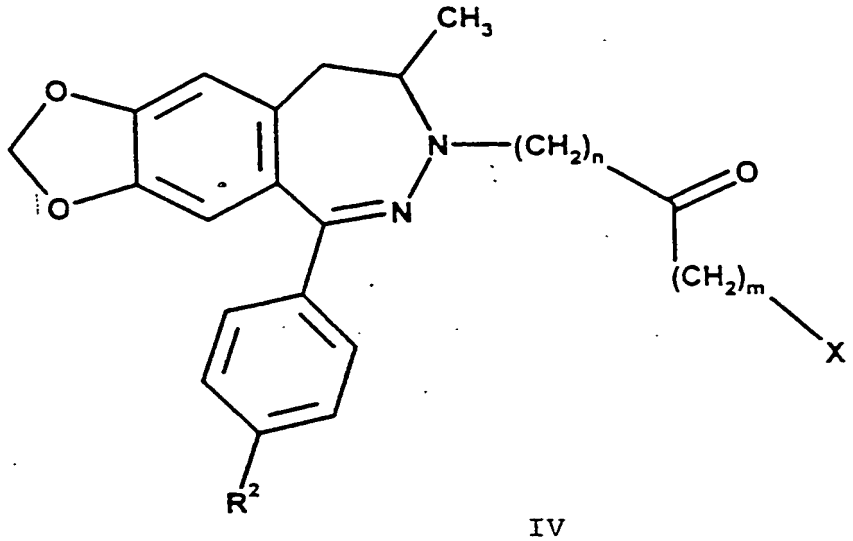
VI

wherein Y represents a leaving group, R^5 is a halo atom or a pyridyl group; or

b) for the preparation of a compound of the formula I, wherein R^1 represents a group of the formula $-(CH_2)_n-CO-(CH_2)_m-R$, wherein R stands for an imidazolyl group, n has a value of 0, m has a value of 0, R^2 means a nitro group, A and B represent a hydrogen atom, the 7,8-dihydro-8-methyl-5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine of the formula III is reacted with 1,1'-carbonyldiimidazole; or

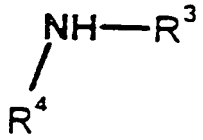
c) for the preparation of a compound of the formula I, wherein R^1 represents a group of the formula $-(CH_2)_n-CO-(CH_2)_m-R$, wherein R stands for a group of the formula $-NR^3R^4$, wherein R^3, R^4, n and m are as defined in connection with formula I, R^2 means a nitro group, A and B represent a hydrogen atom, the 7,8-dihydro-8-methyl-5-(4-nitrophenyl)--9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine of the formula III is reacted with a reagent of the formula VI, wherein Y and R^5 represent,

independently, a leaving group, n and m are as stated above, and the obtained benzodiazepine derivative of the formula IV



IV

wherein X stands for a leaving group, n and m are as stated above, is reacted with an amine of the formula VII

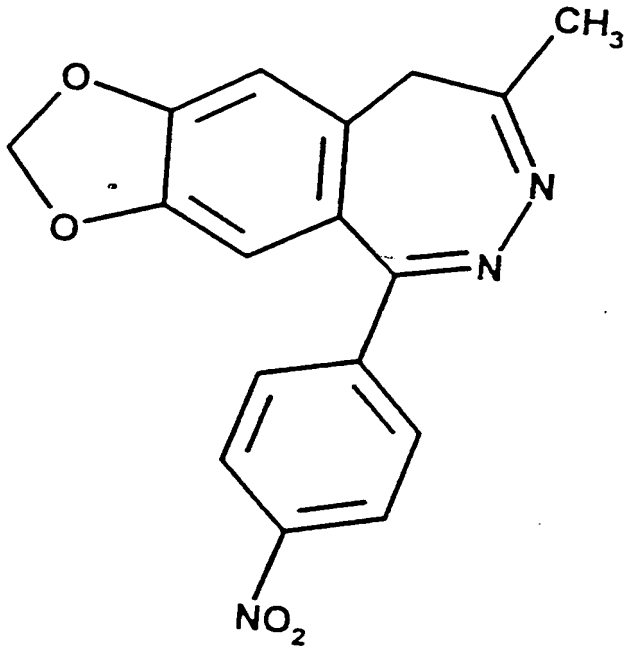


VII

wherein R^3 and R^4 are as stated above; or

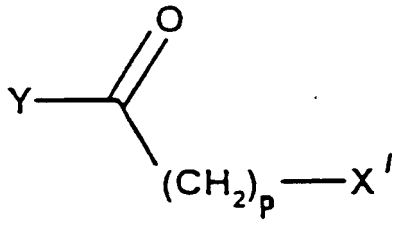
d) for the preparation of a compound of the formula I, wherein R^1 stands for a group of the formula $-CO-(CH_2)_p-R^6$, wherein R^6 represents a halo atom, a phenoxy group or a C_{1-4} alkoxy group, p has a value of 0, 1 or 2, A forms together with B a valence bond, R^2 means a nitro group, the 8-methyl-

-5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine of the formula II



II

is reacted with an acylating agent of the formula IX

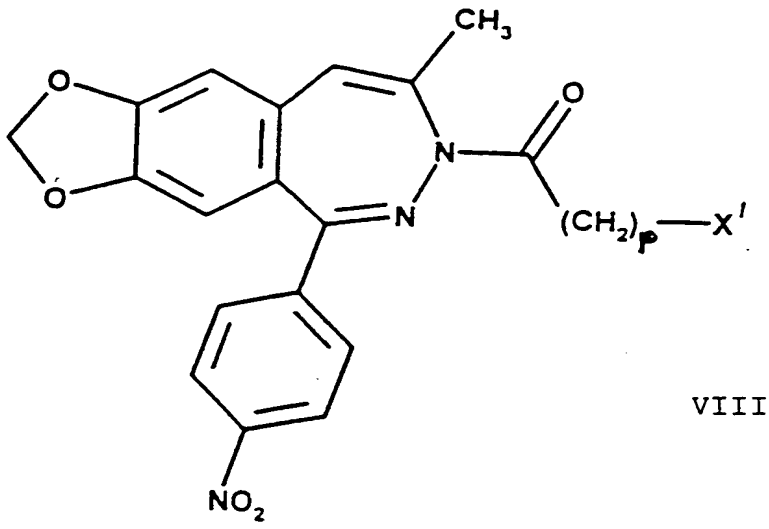


IX

wherein Y represents a leaving group, X' stands for a halo atom, a phenoxy group or a C_{1-4} alkoxy group, p has a value of 0, 1 or 2;
or

e) for the preparation of a compound of the formula I, wherein R^1 stands for a

group of the formula $-CO-(CH_2)_p-R^6$, wherein R^6 represents a group of the formula $-NR^7R^8$, wherein R^7, R^8 and p are as defined in connection with the formula I, A forms together with B a valence bond, R^2 means a nitro group, the 8-methyl-5-(4-nitrophenyl)-9H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine of the formula II is reacted with an acylating agent of the formula IX, wherein each of Y and X' represents, independently, a leaving group, p is as stated above, and the obtained acylated compound of the formula VIII



VIII

wherein X' and p are as defined above, is reacted with an amine of the formula HNR^7R^8, wherein R^7 and R^8 are as stated above;

and, if desired, an obtained compound of the formula I, wherein R^2 represents a nitro group, R^1, A and B are as defined in connection with the formula I, is transformed

into a compound of the formula I, wherein R^2 stands for an amino group, by reduction;

and, if desired, an obtained compound of the formula I, wherein R^2 represents an amino group, R^1, A and B are as defined in connection with the formula I, is reacted with a C_{1-4} alkanecarboxylic acid or a reactive acylating derivative thereof;

and, if desired, an obtained base of the formula I is converted to a pharmaceutically suitable acid addition salt or liberated from the acid addition salt.

If a reagent of the formula VI, wherein n has a value of 0, is used, said reagent is an acylating agent such as a carboxylic halide, a carboxylic anhydride, a carbonate ester, carbonyldiimidazole, an omega-halo-carboxylic halide, an omega-halocarbonate ester etc. The acylation is carried out in the presence or absence of an acid binding agent and/or pyridine, at a temperature of -20 to +150 °C, in the presence or absence of an organic solvent.

If a reagent of the formula VI, wherein n has a value of 1 or 2, is used, said reagent is an alkylating agent, for example the corresponding halide. The alkylation is performed in the presence or absence of an acid binding agent, at a temperature of 20 to 200 °C, in the presence or absence of an organic solvent.

The reaction of the benzodiazepine

derivative of the formula IV and the amine of the formula VII is carried out in a manner known from the literature /Houben-Weyl: Methoden der Organischen Chemie, Band XI, Amine, G. Thieme Verlag, Stuttgart, 1957; S. Patai: The chemistry of amine group, Interscience Publishers, 1968/.

The acylation of the compound of the formula II with the acylating agent of the formula IX and the amination of the compound of the formula VIII with the amine of the formula HNR^7R^8 are performed in a similar manner as described above.

The nitro compounds of the formula I can be reduced in a manner known in itself to obtain the corresponding amino compound. The reduction can be carried out for example with tin(II) chloride or in the presence of a catalyst using a hydrogen source. For example, the catalyst can be Raney nickel, palladium or platinum oxide, the hydrogen source is, for example, hydrazine, hydrazine hydrate, formic acid, a trialkylammonium formate or an alkali metal formate.

If desired, a base of the formula I is reacted with an inorganic or organic acid to transform it into a pharmaceutically suitable acid addition salt, or the base of the formula I is liberated from the acid addition salt using a stronger base.

The starting compound 7,8-dihydro-8--methyl-5-(4-nitrophenyl)-9H-1,3-dioxolo-

/4,5-h//2,3/benzodiazepine of the formula III can be prepared by reducing 8-methyl--5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine of the formula II in an analogous manner as described in the literature /Houben-Weyl: Methoden der Organischen Chemie, Band IV, Reduktion, G. Thieme Verlag, Stuttgart, 1989/ or using the processes known from HU-P No. 186 760.

The compound of the formula II can be prepared by the process known from HU-P No. 191 702.

The reagents of the formulae VI and IX as well as the amines of the formulae VII and HNR^7R^8 are commercially available.

The pharmacological effect of the novel compounds of the formula I was studied by in vitro and in vivo methods. 8-Methyl-5--(4-aminophenyl)-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine (compound "A") known from HUP No. 191 698 and GB-P No. 2 162 184 was used as the reference substance.

In vitro determination of AMPA antagonist effect

PSI (inhibition of population spike) test

The field potentials (population spike) evoked by electric stimulation of the Shaffer collateral comissural pathway were measured in the CA1 neurones of rat hippocampus. The

population spike can be inhibited by AMPA/kainate antagonists. The non-cumulative IC_{50} values are shown in Table I. /Tarnawa, I., Molnár, P., Gaál, L., Andrási, F.: Inhibition of hippocampal field potentials by GYKI 52466 in vitro and in vivo, Acta Physiol. Hung., 79(2), 163-9 (1992)/.

SD (spreading depression) test

The method is based on the phenomenon of spreading depression evoked by kainate in isolated retinal preparation of the chicken. The formation of spreading depression is inhibited (delayed) by AMPA/kainate antagonists. /Sheardown M.J.: The triggering of spreading depression in the chicken retina: a pharmacological study, Brain Res., 607(1-2), 189-194 (1993)/. The obtained IC_{50} values are shown in Table I.

Table I

Results obtained in tests suitable for the determination of in vitro AMPA antagonist effect

Compound (No. of Example)	Percent inhibition of population spike (10 microM)	SD[a] IC_{50} in microM
16	100	1.3
17	95	1.5
19	95	no data
46	no data	6.5
61	no data	2.8
"A"	58	9.5

[a] Spreading depression test.

As shown in Table I, the inhibitory effects of the novel compounds are significantly higher than that of reference compound "A".

In vivo assays

Muscle relaxant effect

The assay was done according to Hoppe in male NMRI mice weighing 20 to 25 g, with 10 animals in each group /Hoppe, J.O., J. Pharmacol. Exp. Ther., 100, 333 (1950)/. Following the ip. treatment of animals, the number of mice showing muscle weakness were

recorded at every 10 minutes in the first hour and at half hour intervals afterwards. The animals falling off the 60° inclined screen within 30 seconds were considered positive. ED_{50} values of the given compounds were determined at each time. The duration of effect was defined as the time of last reading when the effect was at least 30 %. The results obtained are summarized in Table II.

Table II

Muscle relaxant effect

Compound (No. of Example)	Muscle relaxant effect ED_{50} [x] ip. in mg/kg	duration in hr
16	21.1	higher than 2
17	18.1	4
"A"	24.5	1

[x] determined at the time of maximal effect.

Although the muscle relaxant activity of the novel compounds are about the same as that of reference compound "A", the duration of action is significantly longer as shown in Table II.

Maximal electroshock test (MES)

Male NMRI mice weighing 20 to 30 g were used for the method of Swinyard et al. /Swinyard, E.A., Brown, W.C. and Goodman, L.S.: Comparative assays of antiepileptic drugs in mice and rats, J. Pharmacol., 106, 319 (1952)/. The animals, 10 in each group, were treated ip. either with various doses of the test substance or with vehicle. After 30 minutes, a 50 Hz, 40 mA electroshock was applied for 0.4 s through corneal electrodes. The number of animals that developed tonic extensor convulsion of the hind-limbs was registered, percent inhibition was calculated, and ED_{50} values were determined by the method of Litchfield and Wilcoxon /Litchfield, J.T., Wilcoxon, F.A.: A simplified method of evaluating dose-effect experiments, J. Pharmacol. Exp. Ther., 96, 99 (1949)/ and summarized in Table III.

Audiogenic seizure (AS) test

The experiments were carried out by the slightly modified method of De Sarro et al. /De Sarro, G.B., Croucher, M.J. and Meldrum, B.S.: Anticonvulsant action of DS 103-282, Neuropharm., 23, 525 (1984)/. Groups of 8 male DBA/2j strain mice weighing 7 to 14 g were treated ip. with the test substance in 10 ml/kg volume. 15 minutes later, the animals

were placed into a covered glass container (30 cm in diameter) and exposed to a 14 kHz 120 dB tone for 60 s at the most. Seizure response was assessed using the following scale: 0 = normal behaviour, 1 = wild running, 2 = clonus, 3 = tonic flexor seizure, 4 = tonic extensor seizure. The maximum response during the 60 s exposure was recorded for each animal. Lethality was also noted. The ED_{50} values were determined by the method of Litchfield and Wilcoxon concerning the inhibition of clonic seizures and tonic extensor convulsions. The results are summarized in Table III.

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Table III

Anticonvulsant effect following ip. treatment

Compound (No. of Example)	MES[x] ED_{50} in mg/kg	AS[xx] ED_{50} in mg/kg	
		tonic convulsion	clonic convulsion
16	4.6	1.6	2.5
17	3.7	no data	no data
"A"	6.9	3.6	4.3

[x] Inhibition of maximal electroshock.

[xx] Inhibition of sound induced seizure.

The novel compounds are significantly more

effective at the inhibition of maximal electroshock and audiogenic seizure than the reference compound "A" as shown in Table III.

The compound of Example 46 has an approximate anticonvulsive ED_{50} value of 10 mg/kg ip. in the MES test (not shown in Table III), while in 60 mg/kg dose it has no muscle relaxant effect in the inclined screen. In contrast, the anticonvulsive ED_{50} value of the reference compound "A" is 6.9 mg/kg, however, at about 4.5 times higher dose, the reference compound produces about 50 % muscle relaxant effect, and at 60 mg/kg dose all the treated animals showed muscle relaxation. Since strong muscle relaxation may seriously limit the therapeutic application of a drug, the lack of muscle relaxant effect of some novel compounds of the invention provides potential advantage over reference compound "A" in the clinical use.

Global ischemia induced by magnesium chloride

The experiments were carried out as described by Berga et al. /Berga, P., Beckett, P.R., Roberts, D.J., Llenas, J., Massingham, R.: Synergistic interactions between piracetam and dihydroergocristine in some animal models of cerebral hypoxia and ischemia, Arzneim.--Forsch., 36, 1314-1320 (1986)/. Groups of 10 male NMRI mice weighing 20 to 25 g were

treated ip. with the test substance in 10 mg/kg volume. After 30 minutes, saturated aqueous magnesium chloride solution was applied iv. (5 ml/kg) resulting in an immediate cardiac arrest. The elapsed time between the iv. injection and the last gasping was measured (gasping time). The means of the treated groups were expressed as percent of control. Statistical analysis was done by ANOVA followed by DUNCAN test. The dose resulting in 50 % descrease in gasping time (ID_{50}) was calculated by linear regression. The results are shown in Table IV.

Table IV

Increase in gasping time in the magnesium chloride induced global ischemia test in mice

Compound (No. of Example)	Dose in mg/kg ip.	Effect in %	ID_{50} in mg/kg ip.
16	30	61	13
17	30	52	27
"A"	30	55	30

From Table IV it can be seen that the novel compound of Example 16 is as effective at neuroprotection in 13 mg/kg dose as the reference compound "A" in 30 mg/kg dose.

Thus, the novel 8-substituted-9H--1,3-dioxolo/4,5-h//2,3/benzodiazepine derivatives of the formula I can be used as active ingredients of pharmaceutical compositions.

On the basis of the above test results, the novel compounds of the invention - due to their competitive AMPA/kainate antagonist property - have considerable muscle relaxant, neuroprotective and anticonvulsive effects. Consequently, the novel compounds can be used for the treatment of any disease such as epilepsy, diseases resulting in muscle spasm, neurodegenerative diseases, states after stroke, migraine and vomiting, wherein the inhibition of the AMPA/kainate receptors may have a favourable effect.

Some compounds of the invention which possess considerable anticonvulsive and neuroprotective activities, while they have no or weak muscle relaxant effect, can be primarily applied as antiepileptics. In the course of their application, the lack of muscle relaxant action provides notable benefit over the known AMPA/kainate antagonist 2,3-benzodiazepine derivatives.

The pharmaceutical compositions of the invention contain a therapeutically active amount of the compound of the formula I or a pharmaceutically suitable acid addition salt thereof and one or more conventional carrier(s).

The pharmaceutical compositions of the invention are suitable for peroral, parenteral or rectal administration or for local treatment, and can be solid or liquid.

The solid pharmaceutical compositions suitable for peroral administration may be powders, capsules, tablets, film-coated tablets, microcapsules etc., and can comprise binding agents such as gelatine, sorbitol, poly(vinylpyrrolidone) etc.; filling agents such as lactose, glucose, starch, calcium phosphate etc.; auxiliary substances for tabletting such as magnesium stearate, talc, poly(ethyleneglycol), silica etc.; wetting agents such as sodium laurylsulfate etc. as the carrier.

The liquid pharmaceutical compositions suitable for peroral administration may be solutions, suspensions or emulsions and can comprise e.g. suspending agents such as gelatine, carboxymethylcellulose etc.; emulsifiers such as sorbitane monooleate etc.; solvents such as water, oils, glycerol, propyleneglycol, ethanol etc.; preservatives such as methyl p-hydroxybenzoate etc. as the carrier.

Pharmaceutical compositions suitable for parenteral administration consist of sterile solutions of the active ingredient, in general.

Dosage forms listed above as well as other dosage forms are known per se, see e.g.

Remington's Pharmaceutical Sciences, 18th Edition, Mack Publishing Co., Easton, USA (1990).

The pharmaceutical compositions of the invention contain, in general, 0.1 to 95.0 per cent by mass of a compound of the formula I or a pharmaceutically suitable acid addition salt thereof. A typical dose for adult patients amounts to 0.1 to 20 mg of the compound of the formula I or a pharmaceutically suitable acid addition salt thereof, daily. The above dose can be administered in one or more portions. The actual dosage depends on many factors and is determined by the doctor.

The pharmaceutical compositions of the invention are prepared by admixing a compound of the formula I or a pharmaceutically suitableacid addition salt thereof to one or more carrier(s), and converting the mixture obtained to a pharmaceutical composition in a manner known per se. Useful methods are known from the literature, e.g. Remington's Pharmaceutical Sciences.

A preferred subgroup of the pharmaceutical compositions of the invention contains a 1,3--dioxolo/4,5-h//2,3/benzodiazepine derivative of the formula I, wherein

A represents a hydrogen atom,

B means a hydrogen atom,

R^1 stands for a group of the formula $-(CH_2)_n-CO-(CH_2)_m-R$, wherein

R represents a chloro atom, a pyridyl

group or a group of the formula $-NR^3R^4$, wherein

R^3 and R^4 mean, independently, a hydrogen atom, a cyclopropyl group, a C_{1-4} alkoxy group, an amino group, a phenyl group optionally substituted by one or two methyl group(s) or a C_{1-4} alkyl group which latter is optionally substituted by a phenyl group or a saturated heterocyclic group having 5 or 6 members and comprising 1 to 3 nitrogen atom(s) or a nitrogen atom and an oxygen atom as the heteroatom, and the heterocyclic group is optionally substituted by a phenyl group which latter is optionally substituted by 1 to 3 methoxy groups, or

R^3 and R^4 form, with the adjacent nitrogen atom and optionally with a further nitrogen atom or an oxygen atom, a saturated or unsaturated heterocyclic group having 5 or 6 members, being optionally substituted by a phenyl group that is optionally substituted by 1 to 3 methoxy groups, n has a value of 0, 1 or 2,

m has a value of 0, 1 or 2,

R^2 stands for a nitro group or an amino group,

or a pharmaceutically suitable acid addition salt thereof as the active ingredient.

Within the above subgroup, the suitable pharmaceutical compositions of the invention

contain a 1,3-dioxolo/4,5-h//2,3/benzodiazepine derivative of the formula I, wherein

R^3 and R^4 represent, independently, a hydrogen atom, a cyclopropyl group, a methoxy group, an amino group, a dimethylaminophenyl group or a C_{1-2} alkyl group which latter is substituted by a phenyl, morpholino or piperazinyl group, wherein the piperazinyl group is substituted by a methoxyphenyl group, or

R^3 and R^4 form, together with the adjacent nitrogen atom and optionally a further nitrogen atom or oxygen atom, an imidazolyl, morpholino or piperazinyl group, wherein the piperazinyl group is substituted by a methoxyphenyl group,

n has a value of 0 or 1,

m has a value of 0 or 1,

R^2 stands for a nitro group or an amino group,

A represents a hydrogen atom,

B means a hydrogen atom,

or a pharmaceutically suitable acid addition salt thereof as the active ingredient.

Within the above subgroup, the especially preferred pharmaceutical compositions of the invention contain a 1,3-dioxolo/4,5-h//2,3/-benzodiazepine derivative of the formula I, wherein

R^3 represents a hydrogen atom,

R^4 stands for a cyclopropyl group, a methoxy group or an amino group,

n has a value of 0,

m has a value of O,
R^2 means an amino group,
A represents a hydrogen atom,
B means a hydrogen atom,
or a pharmaceutically suitable acid addition salt thereof as the active ingredient.

Another preferred subgroup of the pharmaceutical compositions of the invention contains an 8-methyl-7H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine derivative of the formula I, wherein

A forms together with B a valence bond between the carbon atoms in positions 8 and 9,

R^1 represents a group of the formula $-CO-(CH_2)_p-R^6$, wherein

R^6 stands for a halo atom, a phenoxy group, a C_{1-4} alkoxy group or a group of the formula $-NR^7R^8$, wherein

R^7 and R^8 mean, independently, a hydrogen atom, a guanyl group or a C_{1-4} alkyl group which latter is optionally substituted by a phenyl group or a morpholino group, wherein the phenyl group is optionally substituted by one or two C_{1-2} alkoxy group(s), or

R^7 and R^8 form together with the adjacent nitrogen atom an oxopyrrolidinyl group, a phthalimido group or a saturated heterocyclic group having 5 or 6 members and comprising

one or two nitrogen atom(s) or a nitrogen and an oxygen atom as the heteroatom, and said heterocyclic group is optionally substituted by 1 to 2 identical or different substituent(s) selected from the group consisting of a hydroxy group, a phenyl group, a phenoxy group, a phenyl(C_{1-4} alkyl) group or a phenoxy(C_{1-4} alkyl) group, wherein in case of the substituents listed the phenyl or phenoxy group is optionally substituted by a halo atom or a C_{1-4} alkoxy group,

p has a value of 0, 1 or 2,

R^2 stands for a nitro group or an amino group,

or a pharmaceutically suitable acid addition salt thereof as the active ingredient.

Within the latter subgroup, the suitable pharmaceutical compositions of the invention contain an 8-methyl-7H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine derivative of the formula I, wherein

A forms together with B a valence bond between the carbon atoms in positions 8 and 9,

R^2 represents a nitro group or an amino group,

R^1 stands for a group of the formula $-CO-(CH_2)_p-R^6$, wherein

R^6 means a chloro atom, a phenoxy group, or a group of the formula $-NR^7R^8$, wherein

R^7 and R^8 represent, independently,

a hydrogen atom, a guamyl group or a C_{1-3} alkyl group optionally substituted by a phenyl group, a dimethoxyphenyl group or a morpholino group, or

R^7 and R^8 form with the adjacent nitrogen atom an oxopyrrolidinyl group, a phthalimido group or a saturated heterocyclic group having 5 or 6 members and comprising one or two nitrogen atom(s) or a nitrogen and an oxygen atom as the heteroatom, and said heterocyclic group is optionally substituted by one or two identical or different substituent(s) selected from the group consisting of a hydroxy group, a methoxyphenyl group, a fluorophenyl group, a benzyl group or a (methoxyphenoxy)-(hydroxypropyl) group,

p has a value of 0, 1 or 2,

or a pharmaceutically suitable acid addition salt thereof as the active ingredient.

Within the latter subgroup, the especially preferred pharmaceutical compositions of the invention contain an 8-methyl-7H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine derivative of the formula I, wherein

R^2 represents an amino group,

R^1, A and B are as defined above,

or a pharmaceutically suitable acid addition salt thereof as the active ingredient.

Furthermore, the invention refers to a method of pharmaceutical treatment which comprises administering a therapeutically effective non-toxic amount of a 1,3-dioxolo-/4,5-h//2,3/benzodiazepine derivative of the formula I or a pharmaceutically suitable acid addition salt thereof to a patient suffering from especially epilepsy or a neurodegenerative disease or being in a state after stroke.

The invention is further elucidated, in detail, by means of the following Examples.

Example 1

(±)-7,8-Dihydro-8-methyl-5-(4-nitrophenyl)-9H--1,3-dioxolo/4,5-h//2,3/benzodiazepine-7--carboxylic acid-imidazolide

3.25 g (10.0 mmoles) of (±)-7,8-dihydro--8-methyl-5-(4-nitrophenyl)-9H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine and 1.95 g (12.0 mmoles) of 1,1'-carbonyldiimidazole are boiled in 75 cm^3 of anhydrous tetrahydrofuran for 20 hours. The reaction mixture is cooled with ice-water, the product precipitated is filtered, and washed with 50 cm^3 of diethyl ether.

Thus, 3.58 g (85 %) of the title compound are obtained. M.p.: 244-248 °C.
^1H NMR ($CDCl_3$): δ 8.26 (2H, d, J=9.0 Hz), 7.91 (1H, s), 7.75 (2H, d, J=9.0 Hz), 7.31 (1H, s), 7.04 (1H, s), 6.88 (1H, s), 6.53 (1H, s), 6.08 (1H, d, J=1.3 Hz), 6.05 (1H,

d, J=1.3 Hz), 5.24 (1H, m), 2.99 (1H, dd, J=14.5 and 4.8 Hz), 2.78 (1H, dd, J=14.6 and 10.2 Hz), 1.40 (3H, d, J=6.4 Hz).

Example 2

(±)-7,8-Dihydro-8-methyl-7-nicotinyl-5-(4--nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

3.25 g (10.0 mmoles) of (±)-7,8-dihydro-8-methyl-5-(4-nitrophenyl)--9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine are dissolved in 100 cm^3 of anhydrous dichloromethane, to the solution obtained, 2.43 g (3.25 cm^3, 24.0 mmoles) of triethylamine and, in small portions, 1.96 g (11.0 mmoles) of nicotinic acid hydrochloride are added. The reaction mixture is stirred at room temperature for 4 hours, then washed three times using 30 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. The crude product is crystallized from 70 cm^3 of acetonitrile, and the crystals are washed with 15 cm^3 of diethyl ether.

Thus, 3.40 g (79 %) of the title compound are obtained. M.p.: 226-228 °C.

^1H NMR ($CDCl_3$): δ 8.66 (2H, m), 8.14 (2H, d, J=9.0 Hz), 7.83 (1H, dt, J=7.9 and 2.0 Hz), 7.45 (2H, d, J=9.0 Hz), 7.37 (1H, m), 6.86 (1H, s), 6.51 (1H, s), 6.08 (1H, d, J=1.3 Hz), 6.06 (1H, d, J=1.3 Hz), 5.47 (1H, m),

3.05 (1H, dd, J=14.4 and 4.2 Hz), 2.85 (1H, dd, J=14.4 and 9.6 Hz), 1.33 (3H, d, J=6.4 Hz).

Example 3

(±)-7,8-Dihydro-8-methyl-7-/N-(4-morpholino-ethyl)carbamoyl/-5-(4-nitrophenyl)-9H-1,3--dioxolo/4,5-h//2,3/benzodiazepine

2.09 g (5.0 mmoles) of the imidazolide derivative described in Example 1 are suspended in 100 cm^3 of dichloromethane, and, to the suspension, 1.44 g (1.44 cm^3, 11.0 mmoles) of (4-morpholinoethyl)amine are added. The reaction mixture is boiled for 10 hours, then washed three times using 30 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. The crude product is crystallized from 85 cm^3 of acetonitrile, the crystals are washed with 10 cm^3 of diethyl ether.

Thus, 1.83 g (76 %) of the title compound are obtained. M.p.: 198-203 °C.

^1H NMR ($CDCl_3$): δ 8.24 (2H, d, J=8.9 Hz), 7.68 (2H, d, J=8.9 Hz), 7.07 (1H, t, J=5.0 Hz), 6.73 (1H, s), 6.47 (1H, s), 6.01 (1H, s), 6.01 (1H, s), 6.00 (1H, s), 5.45 (1H, m), 3.71 (4H, m), 3.42 (2H, m), 3.12 (1H, dd, J=14.6 and 2.1 Hz), 2.87 (1H, dd, J=14.7 and 6.6 Hz), 2.55 (2H, m), 2.49 (4H, m), 0.97 (3H, d, J=6.6 Hz).

Example 4

(±)-7-(N-Cyclopropylcarbamoyl)-7,8-dihydro-8--methyl-5-(4-nitrophenyl)-9H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine

2.09 g (5.0 mmoles) of the imidazolide derivative described in Example 1 are boiled in 30 cm^3 of cyclopropylamine for 4 hours, then the amine is distilled off under reduced pressure. The residue is taken up in 75 cm^3 of dichloromethane, washed three times using 30 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. The crude product is crystallized from 50 cm^3 of ethanol, and washed with 10 cm^3 of diethyl ether.

Thus, 1.59 g (78 %) of the title compound are obtained. M.p.: 198-203 °C.
^{1}H NMR /$(CD_3)_2SO$/: δ 8.23 (2H, d, J=8.8 Hz), 7.77 (2H, d, J=8.(Hz), 6.99 (1H, s), 6.85 (1H, d, J=2.8 Hz), 6.48 (1H, s), 6.07 (2H, s), 5.20 (1H, m), 3.00 (1H, dd, J=14.5 and 2.1 Hz), 2.86 (1H, dd, J=14.5 and 7.2 Hz), 2.60 (1H, m), 0.90 (3H, d, J=6.4 Hz), 0.63 (2H, m), 0.53 (2H, m).

Example 5

(±)-7,8-Dihydro-8-methyl-7-(N-methoxy-carbamoyl)-5-(4-nitrophenyl)-9H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine

2.03 g (25.0 mmoles) of methoxyamine

hydrochloride and 3.45 g (25.0 mmoles) of potassium carbonate are stirred in 75 cm^3 of anhydrous dimethylformamide for half an hour, then, 2.09 g (5.0 mmoles) of the imidazolide derivative described in Example 1 are added. The reaction mixture is stirred for 6 hours, then the solvent is evaporated at a pressure of 55 Pa. The residue is suspended in 100 cm^3 of water, stirred for half an hour, filtered, washed with 50 cm^3 of water, and dried. The crude product is recrystallized from 35 cm^3 of tetrahydrofuran, and washed with 10 cm^3 of diethylether.

Thus, 2.30 g (68 %) of the title compound are obtained. M.p.: 156-162 °C.
^1H NMR /$(CD_3)_2SO$/: δ 10.00 (1H, s), 8.24 (2H, d, J=8.8 Hz), 7.90 (2H, d, J=8.8 Hz), 7.03 (1H, s), 6.51 (1H, s), 6.09 (1H, s), 6.08 (1H, s), 5.08 (1H, m), 3.63 (3H, s), 3.02 (1H, dd, J=14.4 and 3.5 Hz), 2.81 (1H, dd, J=14.4 and 8.2 Hz), 0.99 (3H, d, J=6.4 Hz).

Example 6

(±)-7,8-Dihydro-8-methyl-7-[N-/1-(2-methoxy-phenyl)-4-piperazinylethyl/carbamoyl]-5--(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

3.86 g (11.0 mmoles) of 1-(2-methoxy-phenyl)-4-piperazinylethyl ammonium fumarate and 3.04 g (22.0 moles) of potassium carbonate are stirred in a mixture of 75 cm^3 of

dichloromethane and 75 cm^3 of water at room temperature for half an hour. The phases are separated, and the aqueous phase is extracted twice with 30 cm^3 of dichloromethane each time. The combined organic phases are washed with 30 cm^3 of water, and dried over anhydrous magnesium sulfate. To the thus-obtained solution, 2.09 g (5.0 mmoles) of the imidazolide derivative described in Example 1 are added, the mixture is stirred at room temperature for 24 hours, then washed three times using 30 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. The crude product is crystallized from 55 cm^3 of acetonitrile, and washed with 10 cm^3 of diethyl ether.

Thus, 2.17 g (74 %) of the title compound are obtained. M.p.: 238-242 °C.
^1H NMR ($CDCl_3$): δ 8.22 (2H, d, J=8.8 Hz), 7.69 (2H, d, J=8.8 Hz), 7.19 (1H, t, J=4.8 Hz), 7.01 (3H, m), 6.91 (1H, m), 6.73 (1H, s), 6.46 (1H, s), 5.99 (1H, s), 5.98 (1H, s), 5.45 (1H, m), 3.87 (3H, s), 3.46 (2H, m), 3.10 (5H, m), 2.85 (1H, dd, J=14.8 and 6.4 Hz), 2.70 (4H, m), 2.63 (2H, m), 0.98 (3H, d, J=6.6 Hz).

Example 7

(±)-7-(N-Aminocarbamoyl)-7,8-dihydro-8-methyl--5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

2.09 g (5.0 mmoles) of the imidazolide derivative described in Example 1 are suspended in 75 cm^3 of dichloromethane. To the suspension, 1.25 g (1.21 cm^3, 25.0 mmoles) of 98-100 % hydrazine hydrate are added. The reaction mixture is stirred at room temperature for 10 hours, then washed three times using 30 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. The crude product is crystallized from 45 cm^3 of ethanol, and the crystals are washed with 10 cm^3 of diethyl ether.

Thus, 1.04 g (54 %) of the title compound are obtained. M.p.: 219-220 °C.
^1H NMR ($CDCl_3$): δ 8.23 (2H, d, J=9.0 Hz), 7.62 (2H, d, J=9.0 Hz), 7.52 (1H, broad s), 6.73 (1H, s), 6.45 (1H, s), 6.01 (1H, d, J=1.3 Hz), 6.00 (1H, d, J=1.3 Hz), 5.38 (1H, m), 3.82 (2H, broad s), 3.12 (1H, dd, J=14.8 and 2.0 Hz), 2.86 (1H, dd, J=14.8 and 6.5 Hz), 0.99 (3H, d, J=6.6 Hz).

Example 8

(±)-2-/-7,8-Dihydro-8-methyl-5-(4-nitrophenyl)--9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine--7-yl/-N-(2,6-dimethylphenyl)acetamide

A mixture of 9.80 g (30.0 mmoles) of (±)-7,8-Dihydro-8-methyl-5-(4-nitrophenyl)--9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine and 7.10 g (36.0 mmoles) of 2-chloro-N-(2,6--dimethylphenyl)acetamide is heated at 140

°C for 2 hours, then at 160 °C again for 2 hours. The reaction mixture is cooled back and dissolved in 200 cm^3 of chloroform. The organic phase is washed with 50 cm^3 of 10 % aqueous sodium hydroxide and 100 cm^3 of water, dried over anhydrous magnesium sulfate, and evaporated. The evaporation residue is subjected to chromatography over silica gel (Kieselgel G, 0.2-0.063 mm) using a mixture of hexane and acetone as the eluent.

Thus, 4.38 g (30 %) of the title compound are obtained. M.p.: 172-174 °C.
^1H NMR ($CDCl_3$): δ 8.22 (2H, d, J=9.1 Hz), 7.82 (2H, d, J=9.1 Hz), 7.65 (1H, s), 7.03 (3H, s), 6.86 (1H, s), 6.45 (1H, s), 6.02 (2H, bs), 4.15 (1H, d, J=16.8 Hz), 4.05 (1H, m), 3.96 (1H, d, J=16.8 Hz), 2.96 (1H, dd, J=14.0 Hz, J= 5.8 Hz), 2.48 (1H, dd, J=14.0 Hz, J=4.3 Hz), 2.07 (6H, s), 1.3 (3H, d, J=6.2 Hz).

Example 9

(±)-2-/-7,8-Dihydro-8-methyl-5-(4-nitrophenyl)--9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine--7-yl/acetamide

9.80 g (30.0 mmoles) of (±)-7,8-dihydro--8-methyl-5-(4-nitrophenyl)-9H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine and 3.40 g (36 mmoles) of 2-chloroacetamide are heated at 160 °C for 6 hours. The reaction mixture is cooled back, and dissolved in 200 cm^3 of

chloroform. The organic phase is washed with 50 cm^3 of 10 % aqueous sodium hydroxide and 100 cm^3 of water, dried over anhydrous magnesium sulfate, and evaporated. The evaporation residue is subjected to chromatography over silica gel (Kieselgel G, 0.2-0.063 mm) using a mixture of hexane and acetone as the eluent.

Thus, 3.30 g (29 %) of the title compound are obtained. M.p.: 216-218 °C.
^{1}H NMR ($CDCl_3$): δ 8.20 (2H, d, J=9.1 Hz), 7.66 (2H, d, J=9.1 Hz), 7.07 (1H, s), 6.97 (1H, s), 6.87 (1H, s), 6.54 (1H, s), 6.06 (2H, s), 4.10 (1H, m), 3.91 (1H, d, J=16.8 Hz), 3.79 (1H, d, J=16.8 Hz), 3.05 (1H, dd, J=14.0 Hz, J=3.4 Hz), 2.59 (1H, dd, J=14.0 Hz, J=5.2 Hz), 0.97 (3H, d, J=6.2 Hz).

Example 10

(±)-7,8-Dihydro-7-(2-chloroacetyl)-8-methyl--5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

9.80 g (30.0 mmoles) of (±)-7,8-Dihydro-8-methyl-5-(4-nitrophenyl)--9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine are boiled with 20 cm^3 of 2-chloroacetyl chloride for 30 minutes, then the reaction mixture is evaporated, and the residue is suspended in 100 cm^3 of diethyl ether. The crystals obtained are filtered, and washed with 20 cm^3 of diethyl ether.

Thus, 11.22 g (93) of the title compound are obtained. M.p.: 220-222 °C.
^{1}H NMR ($CDCl_3$): δ 8.27 (2H, d, J=9.0 Hz), 7.73 (2H, d, J=9.0 Hz), 6.77 (1H, s), 6.47 (1H, s), 6.03 (2H, s), 5.35 (1H, m), 4.57 (1H, d, J=13.8 Hz), 4.47 (1H, d, J=13.8 Hz), 3.08 (1H, dd, J=14.6 Hz, J=3.2 Hz), 2.82 (1H, dd, J=14.6 Hz, J=8.0 Hz), 1.06 (3H, d, J=6.6 Hz).

Example 11

(±)-7,8-Dihydro-8-methyl-7-[3-/4-(2-methoxyphenyl)piperazinyl/propionyl]-5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

A mixture of 6.40 g (16.0 mmoles) of (±)-7,8-dihydro-7-(2-chloroacetyl)-8-methyl--5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine, 7.68 g (40.0 mmoles) of 4-(2-methoxyphenyl)piperazine and 32 cm^3 of acetonitrile is boiled for 30 minutes. Then, the reaction mixture is evaporated. To the evaporation residue, 50 cm^3 of water are added, the crystals obtained are filtered, and washed with 10 cm^3 of water.

Thus, 7.90 g (89 %) of the title compound are obtained. M.p.: 175-176 °C.

Example 12

(±)-7,8-Dihydro-8-methyl-7-morpholinoacetyl--5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine

A mixture of 6.00 g (15.0 mmoles) of (+)-7,8-dihydro-7-(2-chloroacetyl)-8-methyl--5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine, 3.00 g (36.0 mmoles) of morpholine and 30 cm^3 of acetonitrile is boiled for 2 hours. Then, the reaction mixture is evaporated. To the evaporation residue, 100 cm^3 of diethyl ether are added, the crystals obtained are filtered, and recrystallized from a mixture of 2-propanol and water.

Thus, 4.90 g (73 %) of the title compound are obtained. M.p. 206-208 °C.

Example 13

(±)-7-[2-/N-Benzyl-N-(2-morpholinoethyl)-amino/acetyl]-7,8-dihydro-8-methyl-5-(4--nitrophenyl)-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

A mixture of 4.00 g (10.0 mmoles) of (±)-7,8-dihydro-7-(2-chloroacetyl)-8-methyl--5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine, 5.50 g (25.0 mmoles) of N-benzyl-N-(2-morpholinoethyl)amine and 20 cm^3 of acetonitrile is boiled for 1 hour. Then, the reaction mixture is evaporated. To the evaporation residue, 50 cm^3 of diethyl ether are added, and the crystals obtained are filtered. The mother liquor is evaporated, and the evaporation residue is subjected to chromatography over silica gel (Kieselgel

G, 0.2-0.063 mm) using a mixture of chloroform and methanol as the eluent.

Thus, 5.10 g (87 %) of the title compound are obtained as an oil.

^{1}H NMR ($CDCl_3$): δ 8.22 (2H, d, J=9.0 Hz), 7.61 (2H, d, J=9.0 Hz), 7.3 (5H, m), 6.75 (1H, s), 6.44 (1H, s), 6.02 (2H, s), 5.40 (1H, m), 3.93 (1H, d, J=17.5 Hz), 3.92 (2H, s), 3.77 (1H, d, J=17.5 Hz), 3.66 (4H, t, J=4.7 Hz), 3.04 (1H, dd, J=14.6 Hz, J=2.9 Hz), 2.92 (2H, t, J=7.1 Hz), 2.78 (1H, dd, J=14.6 Hz, J=11.8 Hz), 2.49 (2H, t, J=7.1 Hz), 2.39 (4H, t, J=4.7 Hz), 1.06 (3H, d, J=6.6 Hz).

Examples 14 to 19

A general process for reducing the nitro group of the compounds described in Examples 2 to 7 by catalytical hydrogenation

5.0 mmoles of the nitro compound are dissolved in a mixture of 100 cm^3 of dichloromethane and 100 cm^3 of methanol, and the solution is hydrogenized in the presence of 0.10 g of 10 % palladium/carbon catalyst at room temperature and 5.065×10^5 Pa pressure. Following the hydrogenization, the catalyst is filtered, the solvent is evaporated under reduced pressure, and the crude product is recrystallized. The following compounds are obtained:

Example 14

(±)-5-(4-Aminophenyl)-7,8-dihydro-8-methyl-7--nicotinyl-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

Solvent for crystallization: toluene.
M.p.: 221-223 °C.
Yield: 61 %.
Analysis: for $C_{23}H_{20}N_4O_3$ (400.44)
calculated: C 68.99 %, H 5.03 %, N 13.99 %;
found: C 69.53 %, H 5.16 %, N 13.56 %.
^1H NMR /$CDCl_3$ + $(CD_3)_2SO$, 70 °C/: δ 8.54 (1H, dd, J=4.8 and 1.5 Hz), 8.49 (1H, m), 7.65 (1H, m), 7.31 (1H, dd, J=7.8 and 4.8 Hz), 7.11 (2H, d, J=8.5 Hz), 6.70 (1H, s), 6.57 (1H, s), 6.53 (2H, d, J=8.5 Hz), 6.03 (1H, s), 6.01 (1H, s), 5.21 (1H, m), 5.09 (2H, s), 2.81 (1H, dd, J=13.9 and 5.6 Hz), 2.63 (1H, t, J=13.5 Hz), 1.37 (3H, d, J=6.0 Hz).

Example 15

(±)-5-(4-Aminophenyl)-7,8-dihydro-8-methyl--7-/N-(4-morpholinoethyl)carbamoyl/-9H--1,3-dioxolo/4,5-h//2,3/- benzodiazepine

Solvent for crystallization: dichloromethane.
M.p.: 262-264 °C.
Yield: 66 %.
Analysis: for $C_{24}H_{29}N_5O_4$ (451.53)
calculated: C 63.84 %, H 6.47 %, N 15.51 %;
found: C 63.96 %, H 6.41 %, N 15.30 %.
^1H NMR /$(CD_3)_2SO$/: δ 7.41 (2H, d, J=8.6 Hz),

6.98 (1H, s), 6.65 (2H, d, J=8.6 Hz), 6.54 (1H, s), 6.40 (1H, t, J=5.3 Hz), 6.06 (1H, s), 6.03 (1H, s), 5.50 (2H, broad s), 4.87 (1H, m), 3.64 (4H, m), 3.22 (2H, m), 2.83 (1H, dd, J=13.8 and 5.2 Hz), 2.42 (7H, m), 1.10 (3H, d, J=6.2 Hz).

Example 16

(±)-5-(4-Aminophenyl)-7-(N-cyclopropyl-carbamoyl)-7,8-dihydro-8-methyl-9H-1,3--dioxolo/4,5-h//2,3/benzodiazepine

Solvent for crystallization: ethanol.
M.p.: 158-160 °C.
Yield: 72 %.
Analysis: for $C_{21}H_{22}N_4O_3$ (378.43)
calculated: C 66.65 %, H 5.85 %, N 14.80 %;
found: C 65.96 %, H 6.09 %, N 14.52 %.
^{1}H NMR /$(CD_3)_2SO$/: δ 7.38 (2H, d, J=8.4 Hz), 6.98 (1H, s), 6.57 (2H, d, J=8.4 Hz), 6.53 (1H, s), 6.13 (1H, d, J=3.0 Hz), 6.06 (1H, s), 6.02 (1H, s), 5.68 (2H, broad s), 4.80 (1H, m), 2.78 (1H, dd, J=13.5 and 5.6 Hz), 2.50 (1H, m), 2.35 (1H, t, J=12.7 Hz), 1.07 (3H, d, J=6.1 Hz), 0.55 (2H, m), 0.45 (2H, m).

Example 17

(±)-5-(4-Aminophenyl)-7,8-dihydro-8-methyl--7-(N-methoxycarbamoyl)-9H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine

Solvent for crystallization: ethanol.
M.p.: 159-162 °C.
Yield: 75 %.
Analysis: for $C_{19}H_{20}N_4O_4$ (368.40)
calculated: C 61.95 %, H 5.47 %, N 15.21 %;
found: C 61.62 %, H 5.56 %, N 15.32 %.
^1H NMR ($CDCl_3$): δ 9.23 (1H, s), 7.46 (2H, d, J=8.7 Hz), 6.99 (1H, s), 6.56 (2H, d, J=8.7 Hz), 6.53 (1H, s), 6.07 (1H, d, J=1.0 Hz), 6.03 (1H, d, J=1.0 Hz), 5.68 (2H, broad s), 4.75 (1H, m), 3.53 (3H, s), 2.79 (1H, dd, J=13.7 and 5.7 Hz), 2.36 (1H, dd, J=13.5 and 12.0 Hz), 1.12 (3H, d, J=6.1 Hz).

Example 18

(±)-5-(4-Aminophenyl)-7,8-dihydro-8-methyl--7-[N-/1-(2-methoxyphenyl)-4-piperazinyl-ethyl/carbamoyl]-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine

Solvent for crystallization: diethyl ether.
M.p.: 121-130 °C.
Yield: 81 %.
Analysis: for $C_{31}H_{36}N_6O_4$ (556.67)
calculated: C 66.89 %, H 6.52 %, N 15.11 %;
found: C 66.52 %, H 6.68 %, N 15.02 %.
^1H NMR ($CDCl_3$): δ 7.46 (2H, d, J=8.4 Hz), 6.96 (3H, m), 6.88 (1H, d, J=8.0 Hz), 6.73 (1H, s), 6.67 (1H, t, J=4.8 Hz), 6.60 (2H, d, J=8.4 Hz), 6.59 (1H, s), 5.95 (1H, d, J=1.3 Hz), 5.93 (1H, d, J=1.3 Hz), 5.16 (1H, m), 3.87 (5H, broad s), 3.44 (1H, m), 3.37 (1H,

m), 3.16 (4H, m), 2.84 (1H, dd, J=14.0 and 4.4 Hz), 2.70 (4H, m), 2.65 (1H, dd, J=14.0 and 10.0 Hz), 2.58 (2H, m), 1.17 (3H, d, J=6.4 Hz).

Example 19

(±)-5-(4-Aminophenyl)-7-(N-aminocarbamoyl)--7,8-dihydro-8-methyl-9H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine

Solvent for crystallization: acetonitrile.
M.p.: 160-170 °C.
Yield: 64 %.
Analysis: for $C_{18}H_{19}N_5O_3$ (353.38)
calculated: C 61.18 %, H 5.42 %, N 19.82 %;
found: C 59.68 %, H 5.37 %, N 19.32 %.
^1H NMR ($CDCl_3$): δ 7.42 (2H, d, J=8.6 Hz), 7.07 (1H, s), 6.99 (1H, s), 6.56 (2H, d, J=8.6 Hz), 6.53 (1H, s), 6.07 (1H, d, J=0.8 Hz), 6.03 (1H, d, J=0.8 Hz), 5.68 (2H, s), 4.78 (1H, m), 3.96 (2H, s), 2.78 (1H, dd, J=13.7 and 5.7 Hz), 2.37 (1H, t, J=12.2 Hz), 1.11 (3H, d, J=6.2 Hz).

Example 20

(±)-2-/5-(4-Aminophenyl)-7,8-dihydro-8-methyl--1,3-dioxolo/4,5-h//2,3/benzodiazepine-7--yl/-N-(2,6-dimethylphenyl)acetamide

2.20 g (4.5 mmoles) of (±)-2-/7,8-dihydro--8-methyl5-(4-nitrophenyl)-1,3-dioxolo-/4,5-h//2,3/benzodiazepine-7-yl/-N-(2,6-

-dimethylphenyl)acetamide are dissolved in 22 cm^3 of ethanol, to the solution obtained, 0.22 g 10 % palladium/carbon catalyst suspended in 0.5 cm^3 of water are added. To the reaction mixture, a solution of 1.80 g (21.4 mmoles) of potassium formate in 1.8 cm^3 of water is added, drop by drop. The reaction mixture is stirred at room temperature for 4 hours, then the catalyst is filtered, the solvent is evaporated under reduced pressure, and the crude product is recrystallized from 2-propanol.

Thus, 0.90 g (44 %) of the title compound are obtained. M.p.: 219-221 °C.

Analysis: for $C_{27}H_{28}N_4O_5$ (456.55)

calculated: N 12.33 %;

found: N 11.85 %.

^1H NMR (DMSO-d_6): δ 8.01 (1H, s), 7.26 (2H, d, J=8.5 Hz), 7.0 (4H, m), 6.54 (2H, d, J=8.5 Hz), 6.46 (1H, s), 6.02 (2H, s), 5.52 (2H, s), 3.80 (1H, m), 3.76 (1H, d, J=15.6 Hz), 3.64 (1H, d, J=15.6 Hz), 2.78 (1H, dd, J=13.2 Hz, J=6.2 Hz), 2.35 (1H, dd, J=13.2 Hz, J=5.8 Hz), 1.96 (6H, s), 1.16 (3H, d, J=6.1 Hz).

Example 21

(±)-2-/5-(4-Aminophenyl)-7,8-dihydro-8-methyl--1,3-dioxolo/4,5-h//2,3/benzodiazepine-7--yl/-acetamide

A mixture of 1.52 g (4.0 mmoles) of (±)-2-/7,8-dihydro-8-methyl-5-(4-nitrophenyl)-

-1,3-dioxolo/4,5-h//2,3/benzodiazepine-7-yl/-acetamide, 3.60 g (16.0 mmoles) of tin(II) chloride dihydrate and 60 cm^3 of methanol is boiled for 8 hours, then, further 1.00 g (4.4 mmoles) of tin(II) chloride dihydrate are added to the reaction mixture, and boiling is continued for another 2 hours. The reaction mixture is evaporated, and, to the evaporation residue, 40 cm^3 of water and 40 cm^3 of chloroform are added. The aqueous phase is extracted still twice with 40 cm^3 of chloroform each time. To the aqueous phase, a solution of 4 g of sodium hydroxide in 20 cm^3 of water are added, and the mixture is extracted twice using 40 cm^3 of chloroform each time. The organic phase is washed twice with 30 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated. The evaporation residue is subjected to chromatography over silica gel (Kieselgel G, 0.2-0.063) using a mixture of hexane and acetone as the eluent.

Thus, 0.95 g (68 %) of the title compound are obtained. M.p.: 221-223 °C.
^{1}H NMR (DMSO-d_6): δ 7.22 (2H, d, J=8.7 Hz), 6.99 (1H, s), 6.95 (1H, d, J=3.6 Hz), 6.54 (1H, s), 6.53 (2H, d, J=8.7 Hz), 6.04 (2H, s), 5.94 (1H, d, J=3.6 Hz), 5.48 (2H, s), 3.66 (1H, m), 3.48 (1H, d, J=16.2 Hz), 3.41 (1H, d, J=16.2 Hz), 2.70 (1H, dd, J=5.7, J=13.5 Hz), 2.30 (1H, dd, J=5.7 Hz, J=13.5 Hz), 1.07 (3H, d, J=6.1 Hz).

Example 22

(±)-2-/5-(4-Aminophenyl)-7,8-dihydro-8-methyl--7-[3-/4-(2-methoxyphenyl)piperazinyl/-propionyl]-1,3-dioxolo/4,5-h//2,3/-benzodiazepine-7-yl/-acetamide

A mixture of 8.36 g (15.0 mmoles) of (±)-2-/7,8-dihydro-8-methyl-7-[3-/4-(2--methoxyphenyl)piperazinyl/propionyl]-5--(4-nitrophenyl)-1,3-dioxolo/4,5-h//2,3/-benzodiazepine, 20.40 g (90.0 mmoles) of tin(II) chloride dihydrate and 150 cm^3 of methanol is boiled for 1 hour. The reaction mixture is evaporated, and, to the evaporation residue, 200 cm^3 of water and 100 cm^3 of chloroform are added. The aqueous phase is extracted still twice with 100 cm^3 of chloroform each time. Then, to the aqueous phase, a solution of 25 g of sodium hydroxide in 150 cm^3 of water are added, and the aqueous phase is extracted three times using 150 cm^3 of chloroform each time. The organic phase is washed twice with 150 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated. The evaporation residue is subjected to chromatography over silica gel (Kieselgel G, 0.2-0.063 mm) using a mixture of chloroform and methanol as the eluent.

Thus, 4.36 g (55 %) of the title compound are obtained. M.p.: 253-254 °C.

Analysis: for $C_{30}H_{33}N_5O_4$ (527.63)

calculated: C 68.29 %, H 6.30 %, N 13.27 %;

found: C 57.89 %, H 6.27 %, N 13.31 %.
^{1}H NMR ($CDCl_3$): δ 7.51 (2H, d, J=8.7 Hz), 6.92 (4H, m), 6.76 (1H, s), 6.68 (2H, d, J=8.7 Hz), 6.60 (1H, s), 6.00 (1H, s), 5.95 (1H, s), 5.22 (1H, m), 4.1 (2H, s), 3.84 (3H, s), 3.45 (1H, m), 3.15 (1H, d, J=15.6 Hz), 3.08 (4H, m), 2.65 (6H, m), 1.32 (3H, d, J=6.4 Hz).

Example 23

(±)-5-(4-Aminophenyl)-7,8-dihydro-8-methyl--7-[3-/4-(2-methoxyphenyl)piperazinyl/-propionyl]-1,3-dioxolo/4,5-h//2,3/-benzodiazepine difumarate dihydrate

1.63 g (3.0 mmoles) of (+)-5-(4-aminophenyl)-7,8-dihydro-8-methyl-7-[3-/4-(2--methoxyphenyl)piperazinyl/propionyl]-1,3-dioxolo/4,5-h//2,3/benzodiazepine and 0.7 g (6 mmoles) of fumaric acid are boiled in a mixture of 60 cm^3 of ethanol and 90 cm^3 of dichloromethane for 30 minutes. The hot reaction mixture is filtered, evaporated, and the residue is suspended in 50 cm^3 of diethyl ether. The crystals are filtered.

Thus, 1.75 g (73 %) of the title compound are obtained. M.p.: 162-164 °C.
Analysis: for $C_{38}H_{45}N_5O_{14}$ (795.81)
calculated: C 57.35 %, H 5.70 %, N 8.80 %;
found: C 57.25 %, H 5.67 %, N 8.84 %.
^{1}H NMR (DMSO-d_6): δ 7.38 (2H, d, J=8.7 Hz), 7.01 (1H, s), 6.92 (2H, m), 6.84 (2H, m),

6.62 (7H, m), 6.07 (1H, s), 6.06 (1H, s), 4.95 (1H, m), 3.75 (3H, s), 3.34 (1H, d, J=13.5 Hz), 3.22 (1H, d, J=13.5 Hz), 2.90 (4H, m), 2.80 (1H, dd, J=5.3 Hz, J=13.6 Hz), 2.63 (4H, m), 2.47 (1H, m), 1.18 (3H, d, J=6.2 Hz).

Example 24

(±)-5-(4-Aminophenyl)-7,8-dihydro-8-methyl--7-morpholinoacetyl-9H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

5.00 g (11.0 mmoles) of (±)-7,8-Dihydro--8-methyl-7-morpholinoacetyl-5-(4-nitrophenyl)--9H-1,3-dioxolo/4,5-h//2,3/benzodiazepine are dissolved in 50 cm^3 of ethanol. To the solution, 0.50 g of 10 % palladium/carbon catalyst suspended in 1.0 cm^3 of water are added. Then, to the reaction mixture, a solution of 4.00 g (47.6 mmoles) of potassium formate in 4.0 cm^3 of water are added, drop by drop. The reaction mixture is stirred at room temperature for 2 hours, then again a solution of 2.00 g (23.8 mmoles) of potassium formate in 2.0 cm^3 of water are added, drop by drop. After further 2 hours' stirring, the catalyst is filtered, washed with a large quantity of ethanol, the solvent is evaporated under reduced pressure, and the residue is suspended in 100 cm^3 of diethyl ether. The crystals obtained are filtered, and the crude product is recrystallized from a mixture of acetonitrile and water.

Thus, 3.00 g (65 %) of the title compound are obtained. M.p.: 254-256 °C.
Analysis: for $C_{23}H_{26}N_4O_4$ (422.49)
calculated: N 13.26 %, H 6.20 %;
found: N 13.12 %, H 6.48 %.
^1H NMR ($CDCl_3$): δ 7.49 (2H, d, J=8.6 Hz), 6.75 (1H, s), 6.68 (2H, d, J=8.6 Hz), 6.58 (1H, s), 6.00 (1H, s), 5.97 (1H, s), 5.19 (1H, m), 4.1 (2H, bs), 3.69 (4H, t, J=4.6 Hz), 3.36 (1H, d, J=15.8 Hz), 3.07 (1H, d, J=15.8 Hz), 2.64 (2H, m), 2.53 (4H, m), 1.30 (3H, d, J=6.4 Hz).

Example 25

(±)-5-(4-Aminophenyl)-7-[2-/N-benzyl-N-(2-morpholinoethyl)amino/acetyl]-7,8-dihydro-8-methyl-9H-1,3-dioxolo/4,5h//2,3/-benzodiazepine

5.10 g (8.7 mmoles) of 7-[2-/N-benzyl-N-(2-morpholinoethyl)amino/acetyl]-7,8-dihydro-8-methyl-5-(4-nitrophenyl)-9H-1,3-dioxolo/4,5h//2,3/benzodiazepine are dissolved in 120 cm^3 of methanol. To the solution, 1.30 g of 10 % palladium/carbon catalyst suspended in 11 cm^3 of water are added, and, to the reaction mixture, 7.70 cm^3 (15.8 mmoles) of hydrazine hydrate are added, drop by drop. The reaction mixture is stirred at room temperature for 24 hours, then further 2.00 cm^3 (4.1 mmoles) of hydrazine hydrate are added. After further 48 hours' stirring, the

catalyst is filtered, washed with a large quantity of methanol, the solvent is evaporated under reduced pressure, and the residue is subjected to chromatography over silica gel (Kieselgel G, 0.2-0.063 mm) using a mixture of acetone and hexane as the eluent.

Thus, 3.70 g (77 %) of the title compound are obtained. M.p.: 68-70 °C.

Analysis: for $C_{32}H_{37}N_5O_4$ (555.683)

calculated: N 12.60 %, H 6.71 %;

found: N 12.16 %, H 6.93 %.

^{1}H NMR ($CDCl_3$): δ 7.43 (2H, d, J=8.7 Hz), 7.25 (5H, m), 6.76 (1H, s), 6.64 (2H, d, J=8.7 Hz), 6.51 (1H, s), 6.01 (1H, s), 5.97 (1H, s), 5.20 (1H, m), 3.99 (2H, bs), 3.84 (2H, s), 3.68 (1H, d, J=16.8 Hz), 3.63 (4H, t, J=4.6 Hz), 3.25 (1H, d, J=16.8 Hz), 2.82 (2H, m), 2.65 (2H, m), 2.43 (2H, m), 2.36 (4H, m), 1.26 (3H, d, J=6.2 Hz).

Example 26

Phenyl 8-methyl-5-(4-nitrophenyl)-7H-1,3--dioxolo/4,5-h//2,3/benzodiazepine-7--carboxylate

20.0 g (61.9 mmoles) of 8-methyl-5-(4--nitrophenyl)-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine are added to 600 cm^3 of chloroform, and, to the mixture, 37.2 g (237.6 mmoles) of phenyl chloroformate are added, drop by drop, at 5 to 10 °C in 15 minutes. The suspension is boiled for 7 hours, while

the mixture becomes a clear solution. After cooling, the solution is evaporated under reduced pressure, to the evaporation residue, 300 cm^3 of diethyl ether are added, and the mixture is stirred at 25 °C for 16 hours. The crystals obtained are filtered, and washed three times using 50 cm^3 of diethyl ether each time.

Thus, 26.0 g (94.9 %) of the title compound are obtained. M.p.: 218-220 °C.
^{1}H NMR ($CDCl_3$): δ 8.25 (2H, d, J=9.0 Hz), 7.77 (2H, d, J=9.0 Hz), 7.4 (2H, m), 7.2 (3H, m), 6.81 (1H, s), 6.55 (1H, s), 6.07 (1H, s), 6.02 (1H, s), 6.36 (1H, qa, J=1.1 Hz), 2.36 (3H, d, J=1.1 Hz).

Example 27

7-(2-Chloroacetyl)-8-methyl-5-(4-nitrophenyl)--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

To 45 cm^3 (564.6 mmoles) of chloroacetyl chloride, 15.0 g (46.4 mmoles) of 8-methyl--5-(4-nitrophenyl)-7H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine are added under ice-water cooling in 10 minutes. After 5 minutes' stirring at 25 °C, the solution becomes cloudy. The mixture is stirred at 80 °C for 60 minutes, then boiled for 15 minutes. After cooling, the mixture is poured onto 450 g of ice, stirred for 3 hours, the crystals precipitated are filtered, washed three times using 60 cm^3 of water each time, and dried under a

lamp emitting infra red radiation. The crude product is boiled in 150 cm^3 of ethanol for 5 minutes. After cooling, the crystals are filtered, washed with ethanol and diethyl ether.

Thus, 15.5 g (83.5 %) of the title compound are obtained. M.p.: 228-229 °C.
Analysis: for $C_{19}H_{14}ClN_3O_5$ (399.79)
calculated: N 10.51 %;
found: N 10.28 %.
^1H NMR ($CDCl_3$): δ 8.28 (2H, d, J=8.8 Hz), 7.71 (2H, d, J=8.8 Hz), 6.77 (1H, s), 6.48 (1H, s), 6.38 (1H, bs), 6.05 (2H, s), 4.09 (2H, s), 2.28 (3H, s).

Example 28

7-(3-Chloropropionyl)-8-methyl-5-(4-nitrophenyl)-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

To 45 cm^3 (461.9 mmoles) of 3-chloropropionyl chloride, 15.0 g (46.4 mmoles) of 8-methyl-5-(4-nitrophenyl)-7H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine are added under ice-water cooling in 10 minutes. The mixture is stirred at 25 °C for 22 hours, then poured onto 450 g of ice. After 3 hours' stirring, the crystals precipitated are filtered, washed three times with 60 cm^3 of water each time, and dried under a lamp emitting infra red radiation. The crude product is dissolved in 300 cm^3 of dichloromethane, and washed

with 200 cm^3 of water. The organic phase is evaporated under reduced pressure, and the evaporation residue is boiled in 100 cm^3 of ethanol for 10 minutes. After cooling, the crystals are filtered, washed with ethanol and diethyl ether.

Thus, 14.1 g (73.4 %) of the title compound are obtained. M.p.: 207-209 °C.
Analysis: for $C_{20}H_{16}ClN_3O_5$ (413.82)
calculated: C 58.05 %, H 3.90 %, N 10.15 %, Cl 8.57 %;
found: C 58.66 %, H 4.02 %, N 9.96 %, Cl 8.53 %.
^1H NMR ($CDCl_3$): δ 8.28 (2H, d, J=8.8 Hz), 7.71 (2H, d, J=8.8 Hz), 6.77 (1H, s), 6.48 (1H, s), 6.35 (1H, bs), 6.05 (2H, bs), 3.86 (2H, m), 3.1-2.9 (2H, m), 2.27 (3H, s).

Example 29

8-Methyl-7-methylcarbamoyl-5-(4-nitrophenyl)--7H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine

5 g (11.3 mmoles) of the compound prepared according to Example 26, 50 cm^3 of ethanol and 14.4 cm^3 (136.6 mmoles) of 33 % methylamine in ethanol are transferred to an acid resistant steel bomb tube of 200 cm^3 capacity. The bomb tube is sealed, and the mixture is stirred at 90 °C for 8 hours. The mixture is allowed to stand at 25 °C for a night, on the other day the bomb tube is opened. The crystals precipitated are filtered, washed three times

using 5 cm^3 of ethanol each time, then twice with 20 cm^3 of diethyl ether each time.

Thus, 3.6 g (83.9 %) of the title compound are obtained. M.p.: higher than 250 °C. ^1H NMR ($CDCl_3$): δ 8.25 (2H, d, J=8.8 Hz), 7.67 (2H, d, J=8.8 Hz), 6.70 (1H, s), 6.40 (1H, s), 6.15 (1H, s), 6.10 (1H, m), 6.01 (2H, s), 2.97 (3H, d, J=4.8 Hz), 2.21 (3H, s).

Example 30

8-Methyl-5-(4-nitrophenyl)-7H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine-7-carboxylic acid-(2-morpholino-4-ylethyl)amide

10.0 g (22.6 mmoles) of the compound prepared according to Example 26, 100 cm^3 of ethanol and 19.08 g (146.6 mmoles) of 4-(2-aminoethyl)morpholine are transferred to an acidresistant steel bomb tube of 200 cm^3 capacity. The bomb tube is sealed, and the mixture is stirred at 110 °C for 24 hours. On the next day, the bomb tube is opened, and the mixture is evaporated under reduced pressure. The evaporation residue is stirred in 400 cm^3 of water for 5 hours, then extracted three times using 200 cm^3 of chloroform each time. The organic phase is dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. The 8.0 g of evaporation residue are transferred to a silica gel column that is eluted with a mixture of chloroform and

methanol. The adequate fraction is evaporated, the evaporation residue is stirred in 50 cm^3 of diisopropyl ether for an hour. The crystals are filtered, and washed with diisopropyl ether.

Thus, 5.8 g (35.8 %) of the title compound are obtained. M.p.: 218-220 °C.
^1H NMR (DMSO-d_6): δ 8.27 (2H, d, J=9.0 Hz), 7.88 (2H, d, J=9.0 Hz), 7.06 (1H, t, J=2.8 Hz), 6.98 (1H, s), 6.59 (1H, s), 6.31 (1H, s), 6.12 (2H, s), 3.60 (4H, m), 3.3 (2H, s), 2.5-2.1 (6H, m), 2.09 (3H, s).

Example 31

7-Guanidinocarbonyl-8-methyl-5-(4-nitrophenyl)--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

8.9 g (20 mmoles) of the compound prepared according to Example 26 are suspended in 300 cm^3 of absolute ethanol, and 4.0 g (40 mmoles) of 97 % guanidine hydrochloride are added. To the suspension, 2.3 g of sodium methylate are added in 15 minutes, and the mixture is boiled under stirring for 3 hours. After cooling, the suspension is filtered, and the filtrate is evaporated under reduced pressure. To the evaporation residue, 250 cm^3 of water are added, and, after an hour's stirring, the crystals obtained are filtered, and washed three times using 30 cm^3 of water each time. Thus, 7.6 g of crude product melting at 202-206 °C are obtained which is transferred to a

silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated, the evaporation residue is crystallized in 40 cm^3 of diethyl ether. The crystals are filtered, and washed with diethyl ether.

Thus, 6.1 g (74.8 %) of the title compound are obtained. M.p.: 204-206 °C.
^1H NMR (DMSO-d_6): δ 8.21 (2H, d, J=9.0 Hz), 7.82 (2H, d, J=9.0 Hz), 7.00 (1H, s), 6.50 (1H, s), 6.31 (1H, s), 6.13 (1H, s), 6.05 (1H, s), 2.22 (3H, s).

Example 32

7-(4-Benzylpiperidine-1-ylcarbonyl)-8-methyl-5--(4-nitrophenyl)-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

8.0 g (18 mmoles) of the compound prepared according to Example 26, 80 cm^3 of ethanol and 32 cm^3 (180 mmoles) of 4-benzylpiperidine are transferred to an acid-resistant steel bomb tube having 200 cm^3 capacity. The bomb tube is sealed, and the mixture is stirred at 110 °C for 24 hours. Then the bomb tube is opened, and the mixture is evaporated under reduced pressure. To the evaporation residue, 250 cm^3 of diethyl ether are added, and, after 2 hours' stirring, the crystals obtained are filtered and washed with diethyl ether.

Thus, 6.4 g (60.4 %) of the title compound are obtained. M.p.: 211-212.5 °C.

^{1}H NMR ($CDCl_3$): δ 8.20 (2H, d, J=8.8 Hz), 7.72 (2H, d, J=8.8 Hz), 7.40-7.00 (5H, m), 6.69 (1H, s), 6.46 (1H, s), 6.15 (1H, s), 6.03 (2H, s), 4.00 (2H, d, J=15 Hz), 2.66 (2H, t, J=13 Hz), 2.52 (2H, d, J=7 Hz), 2.07 (3H, s), 1.80-1.50 (3H, m), 1.3-1.1 (2H, m).

Example 33

7-[2-/N-Benzyl-(2-morpholinoethyl)amino/-acetyl]-8-methyl-5-(4-nitrophenyl)-7H--1,3-dioxolo/4,5-h//2,3/benzodiazepine

A mixture of 12.0 g (30 mmoles) of the compound prepared according to Example 27, 250 cm^3 of acetonitrile and 14.9 g (66 mmoles) of benzyl-(2-morpholine-4-ylethyl)amine is boiled for 7 hours. After cooling, the reaction mixture is filtered, and the filtrate is evaporated under reduced pressure. The evaporation residue is dissolved in 300 cm^3 of dichloromethane, washed twice with 100 cm^3 of water each time, and the organic phase is evaporated under reduced pressure. The evaporation residue (11.4 g) is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated under reduced pressure, then treated at a pressure of 0.1 mm Hg.

Thus, 10.0 g (57.1 %) of crystalline foam are obtained. M.p.: 69-70 °C.

Analysis: for $C_{32}H_{33}N_5O_6$ (583.65)

calculated: N 12.00 %;
found: N 11.82 %.
^{1}H NMR ($CDCl_3$): δ 8.23 (2H, d, J=8.8 Hz), 7.59 (2H, d, J=8.8 Hz), 7.25 (5H, m), 6.77 (1H, s), 6.44 (1H, s), 6.33 (1H, s), 6.04 (2H, s), 3.91 (3H, bs), 3.62 (5H, m), 2.93 (2H, m), 2.48 (2H, m), 2.37 (4H, m), 2.28 (3H, s).

Example 34

7-{2-[N-/2-(3,4-Dimethoxyphenyl)ethyl/-methylamino]acetyl}-8-methyl-5-(4-nitrophenyl)--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

A mixture of 14.4 g (36 mmoles) of the compound prepared according to Example 27, 200 cm^3 of acetonitrile and 15 g (76.8 mmoles) of N-/2-(3,4-dimethoxyphenyl)ethyl/methylamine is boiled for 5 hours. After cooling, the reaction mixture is evaporated under reduced pressure. The evaporation residue is crystallized in 200 cm^3 of water, the crystals are filtered, washed three times using 50 cm^3 of water each time, and dried under a lamp emitting infra red radiation. The crude product (19.7 g) is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated under reduced pressure, and the evaporation residue (7.0 g) is dissolved in 20 cm^3 of ethyl acetate. To the solution obtained, a solution of 1.13 g (12.5 mmoles)

of anhydrous oxalic acid in 25 cm^3 of diethyl ether are added. After half an hour's stirring, the crystals precipitated are filtered, and washed with diethyl ether. Thus, 4.8 g of the monooxalate of the title compound are obtained, m.p. 124-125 °C. From the oxalate salt, the base is liberated with a 10 % aqueous sodium hydroxide solution, and extracted with dichloromethane, the organic phase is dried, and evaporated under reduced pressure. The evaporation residue is crystallized from a mixture of hexane and diethyl ether in a ratio of 1:1, and the crystals are filtered.

Thus, 1.6 g of the title compound are obtained. M.p.: 103-105 °C.

Analysis: for $C_{30}H_{30}N_4O_7$ (558.60)

calculated: N 10.03 %;

found: N 9.84 %.

^1H NMR ($CDCl_3$): δ 8.26 (2H, d, J=8.8 Hz), 7.70 (2H, d, J=8.8 Hz), 6.80-6.70 (4H, m), 6.45 (1H, s), 6.34 (1H, s), 6.05 (1H, s), 6.01 (1H, s), 3.85 (7H, bs), 3.5 (1H, bs), 2.80-2.50 (7H, m), 2.28 (3H, d, J=1.1 Hz).

Example 35

1-[2-/8-Methyl-5-(4-nitrophenyl)-7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine-7-yl/-2-oxoethyl]pyrrolidine-2-one

To a solution of 2.85 g (33.5 mmoles) of 2-pyrrolidone in 60 cm^3 of dimethylsulfoxide, 3.75 g (33.4 mmoles) of potassium

tert.-butylate are added. The mixture is stirred for half an hour, then 10.95 g (27.4 mmoles) of the compound prepared according to Example 27 are added at 10 °C. The reaction mixture is stirred at 25 °C for an hour, then, 45 cm^3 of water are added to it, drop by drop, under cooling. The crystals precipitated are filtered, then transferred to a silica gel column that is eluted with a mixture of hexane and acetone. The adequate fraction is evaporated under reduced pressure.

Thus, 3.47 g (28.3 %) of the title compound of yellow colour are obtained. M.p.: 235-237 °C.

^1H NMR ($CDCl_3$): δ 8.30 (2H, d, J=8.8 Hz), 7.70 (2H, d, J=8.8 Hz), 7.06 (1H, s), 6.63 (1H, s), 6.57 (1H, s), 6.13 (2H, bs), 4.6-4.1 (2H, m), 3.28 (2H, m), 2.26 (2H, m), 2.15 (3H, s), 1.96 (2H, m).

Example 36

7-/2-(4-Benzylpiperidinyl)acetyl/-8-methyl--5-(4-nitrophenyl)-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

A mixture of 10.0 g (25 mmoles) of the compound prepared according to Example 27, 250 cm^3 of acetonitrile and 9.64 g (55 mmoles) of 4-benzyl-piperidine is boiled for 4 hours. The reaction mixture is evaporated under reduced pressure. The evaporation residue is crystallized from 250 cm^3 of water, stirred

at 25 °C for 3 hours, the crystals obtained are filtered, and washed with water. The crude product is suspended in 200 cm^3 of diethyl ether, and, after 30 minutes' stirring, filtered, and washed with diethyl ether.

Thus, 10.5 g (78.0 %) of the title compound are obtained. M.p.: 102-104 °C.
Analysis: for $C_{31}H_{30}N_4O_5$ (538.61)
calculated: C 69.13 %, H 5.61 %, N 10.40 %;
found: C 69.27 %, H 5.72 %, N 10.16 %.
^1H NMR ($CDCl_3$): δ 8.26 (2H, d, J=8.8 Hz), 7.68 (2H, d, J=8.8 Hz), 7.30-7.10 (5H, m), 6.75 (1H, s), 6.46 (1H, s), 6.32 (1H, s), 6.05 (2H, bs), 3.60-3.30 (2H, m), 3.00-2.85 (2H, m), 2.50 (2H, m), 2.26 (3H, s), 2.15 (2H, m), 1.6 (3H, m), 1.3 (2H, m).

Example 37

N-[2-/8-Methyl-5-(4-nitrophenyl)-7H-1,3--dioxolo/4,5-h//2,3/benzodiazepine-7-yl/-2--oxoethyl]phthalimide

6.0 g (15.00 mmoles) of the compound prepared according to Example 27 are dissolved in 30 cm^3 of dimethylformamide. To the solution, 0.9 g (5.4 mmoles) of potassium iodide and 3.75 g (20.2 mmoles) of potassium phthalimide are added. The mixture is boiled for 2 hours, then, after cooling, 45 cm^3 of water are added to it, drop by drop. After an hour's stirring, the crystals obtained are filtered, and washed with water. The crude

product is recrystallized from ethanol.

Thus, 3.58 g (46.7 %) of the title compound are obtained. M.p.: 206-209 °C. ^{1}H NMR ($CDCl_3$): δ 8.28 (2H, d, J=8.8 Hz), 7.88 (2H, d, J=8.8 Hz), 7.74 (4H, m), 6.74 (1H, s), 6.53 (1H, s), 6.30 (1H, s), 6.05 (2H, bs), 4.82 (2H, m), 2.26 (3H, s).

Example 38

8-Methyl-7-[2-/4-(2-methoxyphenyl)-piperazinyl/acetyl]-5-(4-nitrophenyl)-7H--1,3-dioxolo/4,5-h//2,3/benzodiazepine

A mixture of 12.0 g (30 mmoles) of the compound prepared according to Example 27, 150 cm^3 of acetonitrile and 12.8 g (66.6 mmoles) of 1-(2-methoxyphenyl)piperazine is boiled for 6 hours. After cooling, the reaction mixture is filtered, and the filtrate is evaporated under reduced pressure. The evaporation residue is crystallized from 150 cm^3 of water, stirred at 25 °C for half an hour, the crystals obtained are filtered, and washed with water. The 16.0 g (96 %) of crude product are transferred to a silica gel column that is eluted with a mixture of hexane and acetone. The adequate fraction is evaporated under reduced pressure, the evaporation residue is crystallized from a mixture of petroleum ether (b.p.: 30-40 °C) and diethyl ether in a ratio of 2:1, and the crystals are filtered.

Thus, 10.1 g (60.6 %) of the title compound are obtained. M.p.: 119-120 °C. ^{1}H NMR ($CDCl_3$): δ 8.28 (2H, d, J=8.8 Hz), 7.88 (2H, d, J=8.8 Hz), 7.00-6.80 (4H, m), 6.78 (1H, s), 6.50 (1H, s), 6.35 (1H, bs), 6.04 (2H, bs), 3.85 (3H, s), 3.68 (1H, m), 3.48 (1H, m), 3.10 (4H, bs), 2.85 (2H, m), 2.75 (2H, m), 2.30 (3H, s).

Example 39

8-Methyl-7-[2-/4-(3-methoxyphenyl)-piperazinyl/acetyl]-5-(4-nitrophenyl)-7H--1,3-dioxolo/4,5-h//2,3/benzodiazepine

A mixture of 4.36 g (10.9 mmoles) of the compound prepared according to Example 27, 70 cm^3 of acetonitrile and 4.2 g (21.8 mmoles) of 1-(3-methoxyphenyl)piperazine is boiled for 7 hours. After cooling, the reaction mixture is filtered, and the filtrate is evaporated under reduced pressure. The evaporation residue is crystallized from 30 cm^3 of water, stirred at 25 °C for half an hour, the crystals obtained are filtered, and washed with water. The 5.0 g of crude product are recrystallized from 100 cm^3 of ethyl alcohol, the crystals obtained are filtered, and washed with diisopropyl ether.

Thus, 4.0 g (66.1 %) of the title compound are obtained. M.p.: 206-208 °C. ^{1}H NMR ($CDCl_3$): δ 8.28 (2H, d, J=8.8 Hz), 7.71 (2H, d, J=8.8 Hz), 7.15 (1H, t, J=8.2

Hz), 6.77 (1H, s), 6.55-6.35 (5H, m), 6.04 (2H, bs), 3.77 (3H, s), 3.60 (2H, m), 3.20 (4H, t, J=4.6 Hz), 2.80 (4H, m), 2.30 (3H, d, J=0.9 Hz).

Example 40

(±)-7-{2-[4-/2-Hydroxy-3-(2-methoxy-phenoxy)propyl/piperazinyl]acetyl}-8-methyl--5-(4-nitrophenyl)-7H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine

A mixture of 20 g (50 mmoles) of the compound prepared according to Example 27, 300 cm^3 of acetonitrile and 29.0 g (108.9 mmoles) of 1-(2-methoxyphenoxy)-3-piperazine--1-yl-2-propanol is boiled for 7 hours, then further 5.1 g (19.2 mmoles) of 1-(2-methoxy-phenoxy)-3-piperazine-1-yl-2-propanol are added to the mixture. The reaction mixture is boiled for further 24 hours, then cooled, and evaporated under reduced pressure. From the oily evaporation residue, twice 300 cm^3 of water are decanted, then the residue is dissolved in 450 cm^3 of dichloromethane, and the organic solution is washed twice using 300 cm^3 of water each time. The dichloromethane phase is dried, and evaporated under reduced pressure. The evaporation residue is crystallized from 200 cm^3 of water, stirred at 25 °C for 3 hours, the crystals obtained are filtered, and washed with water. The 19.2 g of crude product are transferred to a silica

gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated, the evaporation residue is crystallized from diisopropyl ether, the crystals are filtered, and washed with diisopropyl ether.

Thus, 11.2 g (35.6 %) of the title compound are obtained. M.p.: 160-161.5 °C. Analysis: for $C_{33}H_{35}N_5O_8$ (629.68) calculated: C 62.95 %, H 5.60 %, N 11.12 %; found: C 63.52 %, H 5.55 %, N 11.08 %. ^1H NMR ($CDCl_3$): δ 8.28 (2H, d, J=8.8 Hz), 7.69 (2H, d, J=8.8 Hz), 7.00-6.85 (4H, m), 6.77 (1H, s), 6.49 (1H, s), 6.34 (1H, s), 6.05 (2H, m), 4.15 (1H, m), 4.01 (2H, d, J=5.2 Hz), 3.85 (3H, s), 3.65 (1H, m), 3.40 (1H, m), 2.70 (4H, m), 2.55 (6H, m), 2.23 (3H, d, J=1.0 Hz).

Example 41

8-Methyl-7-{3-[N-/2-(3,4-dimethoxyphenyl)-ethyl/methylamino]propionyl}-5-(4-nitrophenyl)-7H-1,3-dioxolo-/4,5-h//2,3/-benzodiazepine

A mixture of 14.9 g (36 mmoles) of the compound prepared according to Example 28, 200 cm^3 of acetonitrile and 15.0 g (76.8 mmoles) of N-/2-(3,4-dimethoxyphenyl)ethyl/-methylamine is boiled for 3 hours. After cooling, the reaction mixture is filtered, the filtrate is evaporated under reduced

pressure. The evaporation residue is dissolved in 400 cm^3 of dichloromethane, and washed three times using 100 cm^3 of water each time. The organic phase is dried, and evaporated under reduced pressure. The evaporation residue (18.5 g) is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated under reduced pressure, then treated at a pressure of 0.1 mm Hg, and the crystals are collected.

Thus, 15.3 g (74.3 %) of the title compound are obtained. M.p.: 64-66 °C.
Analysis: for $C_{31}H_{32}N_4O_7$ (572.62)
calculated: N 9.78 %;
found: N 9.48 %.
^1H NMR ($CDCl_3$): δ 8.24 (2H, d, J=8.7 Hz), 7.64 (2H, d, J=8.7 Hz), 6.80-6.70 (3H, m), 6.77 (1H, s), 6.48 (1H, s), 6.33 (1H, s), 6.04 (1H, s), 5.95 (1H, s), 3.85 (3H, s), 2.90-2.60 (8H, m), 2.37 (3H, s), 2.28 (3H, s).

Example 42

7-[3-/N-Benzyl-(2-morpholinoethyl)amino/-propionyl]-8-methyl-5-(4-nitrophenyl)-7H--1,3-dioxolo/4,5-h//2,3/- benzodiazepine

A mixture of 10.34 g (25 mmoles) of the compound prepared according to Example 28, 250 cm^3 of acetonitrile and 12.42 g (55.0 mmoles) of benzyl-(2-morpholine-4-ylethyl)amine

is boiled for 8 hours. The reaction mixture is evaporated under reduced pressure. The evaporation residue is crystallized from 150 cm^3 of water, stirred at 25 °C for 2 hours, the crystals obtained are filtered, and washed with water. The crude product (10.8 g) is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated under reduced pressure, and treated at a pressure of 0.1 mm Hg. The crystals are collected.

Thus, 9.2 g (61.7 %) of the title compound are obtained. M.p.: 74-75 °C.
Analysis: for $C_{33}H_{35}N_5O_6$ (597.68)
calculated: C 66.32 %, H 5.90 %, N 11.72 %;
found: C 65.85 %, H 5.80 %, N 11.78 %.
^1H NMR ($CDCl_3$): δ 8.23 (2H, d, J=8.7 Hz), 7.59 (2H, d, J=8.7 Hz), 7.25 (5H, m), 6.75 (1H, s), 6.39 (1H, s), 6.33 (1H, s), 6.02 (2H, s), 3.65 (6H, m), 3.00-2.40 (12H, m), 2.28 (3H, d, J=1.2 Hz).

Example 43

8-Methyl-7-[3-/4-(2-methoxyphenyl)-piperazinyl/propionyl]-5-(4-nitrophenyl)--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

A mixture of 12.4 g (30 mmoles) of the compound prepared according to Example 28, 150 cm^3 of acetonitrile and 12.8 g (66.6 mmoles) of 1-(2-methoxyphenyl)piperazine is

boiled for 2.5 hours. After cooling, the reaction mixture is filtered, and the filtrate is evaporated under reduced pressure. The evaporation residue is crystallized from 150 cm^3 of water, stirred at 25 °C for 2 hours, the crystals obtained are filtered, and washed with water. The 17.0 g of crude product is heated to boiling in 120 cm^3 of water, and the latter is decanted from the oil. To the residue, 50 cm^3 of diisopropyl ether are added to crystallize the product. After an hour's stirring at 25 °C, the crystals obtained are filtered, and washed three times using 10 cm^3 of diisopropyl ether each time.

Thus, 15.4 g (90.2 %) of the title compound are obtained. M.p.: 171-173 °C.
Analysis: for $C_{31}H_{31}N_5O_6$ (569.62)
calculated: N 12.29 %;
found: N 12.39 %.
^1H NMR ($CDCl_3$): δ 8.27 (2H, d, J=8.7 Hz), 7.75 (2H, d, J=8.7 Hz), 7.00-6.80 (4H, m), 6.77 (1H, s), 6.50 (1H, s), 6.34 (1H, bs), 6.00 (2H, m), 3.86 (3H, s), 3.30-2.60 (12H, m), 2.28 (3H, s).

Example 44

8-Methyl-7-[3-/4-(3-methoxyphenyl)-piperazinyl/propionyl]-5-(4-nitrophenyl)--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

A mixture of 6.12 g (14.8 mmoles) of the compound prepared according to Example

28, 100 cm^3 of acetonitrile and 5.5 g (28.6 mmoles) of 1-(3-methoxyphenyl)piperazine is boiled for 7 hours. The reaction mixture is evaporated under reduced pressure. The evaporation residue is crystallized from 150 cm^3 of water, stirred at 25 °C for an hour, the crystals obtained are filtered, and washed with water. The 8.0 g of crude product are transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated under reduced pressure. The evaporation residue is crystallized from 85 cm^3 of diethyl ether. After an hour's stirring at 25 °C, the crystals obtained are filtered, and washed three times using 10 cm^3 of diethyl ether each time.

Thus, 5.06 g (60.1 %) of the title compound are obtained. M.p.: 165-166 °C.
^1H NMR (DMSO-d_6): δ 8.33 (2H, d, J=8.8 Hz), 7.77 (2H, d, J=8.8 Hz), 7.10 (2H, m), 6.68 (1H, s), 6.54 (1H, s), 6.506.30 (3H, m), 6.15 (1H, s), 6.10 (1H, s), 3.71 (3H, s), 3.40-2.60 (12H, m), 2.17 (3H, s).

Example 45

7-[3-/4-(4-Fluorophenyl)-4-hydroxy-piperidinyl/propionyl]-8-methyl-5--(4-nitrophenyl)-7H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine

A mixture of 12.4 g (30 mmoles) of the compound prepared according to Example 28,

250 cm^3 of acetonitrile and 12.9 g (66.1 mmoles) of 4-(4-fluorophenyl)piperidine-4-ol is boiled for 2 hours. After cooling, the reaction mixture is evaporated under reduced pressure. The evaporation residue is crystallized from 300 cm^3 of water, stirred at 25 °C for 2 hours, the crystals obtained are filtered, and washed with water. The 17.0 g of crude product are suspended in 100 cm^3 of diisopropyl ether, and, after an hour's stirring at 25 °C, the crystals are filtered, and washed three times using 20 cm^3 of diisopropyl ether each time.

Thus, 16.5 g (96.1 %) of the title compound are obtained. M.p.: 134-136 °C.
Analysis: for $C_{31}H_{29}FN_4O_6$ (572.60)
calculated: N 9.78 %;
found: N 9.88 %.
^1H NMR (DMSO-d_6): δ 8.33 (2H, d, J=8.8 Hz), 7.77 (2H, d, J=8.8 Hz), 7.46 (2H, m), 7.07 (3H, m), 6.61 (1H, s), 6.51 (1H, s), 6.15 (1H, s), 6.10 (1H, s), 4.90 (1H, s), 3.40-2.40 (13H, m), 2.18 (3H, s), 1.90 (2H, m), 1.60 (2H, m).

Example 46

5-(4-Aminophenyl)-8-methyl-7H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine-7-carboxylic acid-(2-morpholino-4-ylethyl)amide

2.0 g (4.17 mmoles) of the compound prepared according to Example 30 are

transferred into a mixture of 80 cm^3 of ethanol and 20 cm^3 of water. To the mixture, 0.4 g of 10 % palladium/carbon catalyst, then, in 4 minutes, 4.0 cm^3 (80.6 mmoles) of 98 % hydrazine hydrate are added at 15 to 20 °C. The mixture is stirred at 25 °C for 4.5 hours, the catalyst is filtered, and washed with ethanol. The filtrate is evaporated under reduced pressure, and, to the residue, 120 cm^3 of water are added. After an hour's stirring, the crystals are filtered, and washed with water. The crude product is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated, and the evaporation residue is crystallized from diethyl ether. The crystals obtained are filtered, and washed with diethyl ether.

Thus, 0.52 g (27.8 %) of the title compound are obtained. M.p.: 249-251 °C.
Analysis: for $C_{24}H_{27}N_5O_4$ (449.51)
calculated: C 64.13 %, H 6.05 %, N 15.58 %;
found: C 64.36 %, H 6.20 %, N 15.20 %.
^1H NMR ($CDCl_3$): δ 7.36 (2H, d, J=8.3 Hz), 6.79 (1H, m), 6.67 (2H, s), 6.65 (2H, d, J=8.3 Hz), 6.13 (1H, s), 6.01 (1H, s), 5.95 (1H, s), 4.01 (2H, bs), 3.80 (4H, t, J=4.5 Hz), 3.5-3.3 (2H, m), 2.65-2.4 (6H, m), 2.23 (3H, s).

Example 47

5-(4-Aminophenyl)-7-(guanidinocarbonyl)-8--methyl-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine monohydrate

3.0 g (7.34 mmoles) of the compound prepared according to Example 31 are transferred into a mixture of 150 cm^3 of methanol and 30 cm^3 of water. To the mixture, 0.9 g of 10 % palladium/carbon catalyst are added, then, in 15 minutes, 6.0 cm^3 (120 mmoles) og 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 2.5 hours. Then, the catalyst is filtered, and washed with methanol. The filtrate is evaporated under reduced pressure, and, to the residue, 100 cm^3 of water are added. After an hour's stirring, the crystals are filtered, and washed with water. The crude product is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated, and the evaporation residue is crystallized from diethyl ether. The crystals obtained are filtered, and washed with diethyl ether.

Thus, 1.54 g (55.6 %) of the title compound are obtained. M.p.: 216-218 °C.
^1H NMR (DMSO-d_6): δ 7.19 (2H, d, J=8.4 Hz), 7.1-6.65 (2H, br), 6.92 (1H, s), 6.64 (1H, s), 6.54 (2H, d, J=8.4 Hz), 6.22 (1H, s), 6.11 (1H, s), 6.04 (1H, s), 5.55 (2H, s),

3.32 (2H, s), 2.19 (3H, s).

Example 48

5-(4-Aminophenyl)-7-/(4-benzylpiperidine-1--yl)carbonyl/-8-methyl-7H-1,3-dioxolo-/4,5-h//2,3/benzodiazepine

5.0 g (9.5 mmoles) of the compound prepared according to Example 32 are dissolved in a mixture of 200 cm^3 of chloroform and 90 cm^3 of methanol. To the solution obtained, 5.0 g of 10 % palladium/carbon catalyst suspended in 10 cm^3 of methanol are added, and the mixture is vigorously stirred under hydrogen atmosphere at room temperature. The reduction is finished in 16 hours. The catalyst is filtered, washed three times using 50 cm^3 of methanol each time, and the filtrate is evaporated under reduced pressure. The evaporation residue is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated under reduced pressure. To the residue, 20 cm^3 of diethyl ether are added, and the mixture is stirred for an hour. The crystals obtained are filtered, washed three times using 10 cm^3 of diethyl ether each time, and dried under a lamp emitting infra red radiation.

Thus, 1.4 g (32.6 %) of the title compound are obtained. M.p.: 179-181 °C.

Analysis: for $C_{30}H_{30}N_4O_3$ (494.60):

calculated: N 11.33 %;
found: N 11.06 %.
^{1}H NMR ($CDCl_3$): δ 7.67 (1H, s), 7.4-7.2 (4H, m), 7.2-7.05 (4H, m), 6.87 (1H, s), 6.80 (1H, d, J=2.4 Hz), 6.78 (1H, d, J=2.4 Hz), 6.08 (2H, s), 4.20 (2H, br), 4.10 (2H, m), 2.72 (3H, s), 2.70-2.55 (1H, m), 2.50-2.45 (1H, m), 2.43 (2H, d, J=7.2 Hz), 1.6 (1H, m), 1.5 (1H, m), 1.4 (1H, m), 1.1-0.95 (1H, m), 0.85-0.70 (1H, m).

Example 49

5-(4-Aminophenyl)-8-methyl-7-/2-(2-morpholino-ethylamino)acetyl/-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine monohydrate

6.0 g (10.3 mmoles) of the compound prepared according to Example 33 are transferred into a mixture of 240 cm^3 of methanol and 50 cm^3 of water. To the mixture, 4.8 g of 10 % palladium/carbon catalyst, then, in 20 minutes, 24.0 cm^3 (484 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 ^oC. The mixture is stirred at 25 ^oC for 100 hours, then further 2.4 g of 10 % palladium/carbon catalyst and 12.0 cm^3 (242 mmoles) of 98 % hydrazine hydrate are added. After further 72 hours' stirring, the catalyst is filtered, washed with methanol, and the filtrate is evaporated under reduced pressure. To the residue, 100 cm^3 of water and 150 cm^3 of dichloromethane are added. After 5 minutes'

stirring, the phases are separated, the aqueous phase is still extracted twice with 150 cm^3 of dichloromethane each time. The organic phase is dried, and evaporated under reduced pressure. The evaporation residue is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated, and the evaporation residue is crystallized from diisopropyl ether. The crystals obtained are filtered, and washed with diisopropyl ether.

Thus, 3.65 g (76.7 %) of the title compound are obtained. M.p.: 92-94 °C.
Analysis: for $C_{25}H_{29}N_5O_4.H_2O$ (481.56)
calculated: N 14.54 %;
found: N 14.25 %.
^1H NMR (DMSO-d_6): δ 7.18 (2H, d, J=8.4 Hz), 7.00 (1H, s), 6.72 (1H, s), 6.58 (2H, d, J=8.4 Hz), 6.48 (1H, s), 6.15 (1H, s), 6.08 (1H, s), 5.75 (2H, bs), 3.73 (1H, d, J=16.9 Hz), 3.54 (4H, t, J=4.6 Hz), 3.30 (1H, d, J=16.9 Hz), 3.05 (1H, m), 2.62 (2H, t, J=6.0 Hz), 2.40-2.25 (6H, m), 2.16 (3H, s).

Example 50

5-(4-Aminophenyl)-7-{2-[N-/2-(3,4-dimethoxyphenyl)ethyl/methylamino]acetyl}-8-methyl--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

7.0 g (12.5 mmoles) of the compound prepared according to Example 34 are added

to a mixture of 400 cm^3 of ethanol and 84 cm^3 of water. To the mixture, 2.8 g of 10 % palladium/carbon catalyst, and, in 30 minutes, 17.5 cm^3 (353 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 73 hours. Then, the catalyst is filtered, washed with ethanol, and the filtrate is evaporated under reduced pressure. To the residue, 80 cm^3 of water are added. After an hour's stirring, the crystals are filtered, and washed with water. The crude product is suspended in diisopropyl ether, then filtered, and washed with diisopropyl ether.

Thus, 3.95 g (59.8 %) of the title compound are obtained. M.p.: 88-90 °C.
Analysis: for $C_{30}H_{32}N_4O_5$ (528.59)
calculated: N 10.60 %;
found: N 10.32 %.
^1H NMR ($CDCl_3$): δ 7.32 (2H, d, J=8.6 Hz), 6.80-6.67 (5H, m), 6.65 (2H, d, J=8.6 Hz), 6.31 (1H, s), 6.03 (1H, s), 5.96 (1H, s), 3.98 (2H, bs), 3.83 (6H, s), 3.79 (1H, d, J=16.2 Hz), 3.41 (1H, d, J=16.2 Hz), 2.85-2.65 (4H, m), 2.46 (3H, s), 2.28 (3H, s).

Example 51

5-(4-Aminophenyl)-8-methyl-7-[2-/4-(2--methoxyphenyl)piperazinyl/acetyl]-7H-1,3--dioxolo/4,5-h//2,3/benzodiazepine

5.5 g (9.9 mmoles) of the compound

prepared according to Example 38 are added to a mixture of 220 cm^3 of ethanol and 55 cm^3 of water. To the mixture, 1.65 g 10 % palladium/carbon catalyst, and, in 10 minutes, 9.0 cm^3 (182 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 2 hours. Then, the catalyst is filtered, washed with ethanol, and the filtrate is evaporated under reduced pressure. To the residue, 170 cm^3 of water are added. After 2 hours' stirring, the crystals are filtered, and washed with water. The crude product is suspended in diisopropyl ether, then filtered, and washed with diisopropyl ether.

Thus, 4.3 g (81.4 %) of the title compound are obtained. M.p.: 130-132 °C.
^{1}H NMR ($CDCl_3$): δ 7.33 (2H, d, J=8.7 Hz), 7.0-6.8 (4H, m), 6.74 (1H, s), 6.73 (1H, s), 6.66 (2H, d, J=8.7 Hz), 6.32 (1H, d, J=1.4 Hz), 6.04 (1H, d, J=1.3 Hz), 5.99 (1H, d, J=1.3 Hz), 4.03 (2H, bs), 3.84 (3H, s), 3.68 (1H, d, J=15.6 Hz), 3.39 (1H, d, J=15.6 Hz), 3.1 (4H, bs), 2.902.65 (4H, m), 2.30 (3H, d, J=1.1 Hz).

Example 52

(±)-5-(4-Aminophenyl)-7-{2-[4-/2-hydroxy--3-(2-methoxyphenoxy)propyl/piperazinyl]-acetyl}-8-methyl-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

6.3 g (10 mmoles) of the compound prepared according to Example 15 are added to a mixture of 180 cm^3 of ethanol and 36 cm^3 of water. To the mixture, 2.5 g of 10 % palladium/carbon catalyst, and, in 15 minutes, 12.0 cm^3 (242 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 4 hours, then the catalyst is filtered, washed with ethanol, and the filtrate is evaporated under reduced pressure. To the residue, 200 cm^3 of water are added. After 2 hours' stirring, the crystals are filtered, and washed with water. The crude product is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated, and the evaporation residue is crystallized from diethyl ether. The crystals obtained are filtered, and washed with diethyl ether.

Thus, 3.4 g (56.8 %) of the title compound are obtained. M.p.: 118-120 °C.

^1H NMR ($CDCl_3$): δ 7.30 (2H, d, J=8.7 Hz), 7.00-6.80 (4H, m), 6.72 (1H, s), 6.71 (1H, s), 6.64 (2H, d, J=8.7 Hz), 6.3 (1H, d, J=1.1 Hz), 6.02 (1H, s), 5.97 (1H, s), 4.09 (1H, m), 4.01 (4H, m), 3.83 (3H, s), 3.63 (1H, dd, J=15.7 and 2.7 Hz), 3.33 (1H, dd, J=15.7 Hz and 2.6 Hz), 2.67 (4H, m), 2.62-2.42 (7H, m), 2.28 (3H, d, J=1.1 Hz).

Example 53

5-(4-Aminophenyl)-7-[3-/2-(3,4-dimethoxyphenyl)-N-methylethylamino/propionyl]-8--methyl-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine dihydrate

3.0 g (5.2 mmoles) of the compound prepared according to Example 41 are added to a mixture of 100 cm^3 of methanol and 20 cm^3 of water. To the mixture, 2.4 g of 10 % palladium/carbon catalyst, and, in 30 minutes, 12.0 cm^3 (242 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 22.5 hours. Then, the catalyst is filtered, washed with methanol, and the filtrate is evaporated under reduced pressure. To the residue, 50 cm^3 of water are added. After an hour's stirring, the crystals are filtered, and washed with water. The crude product is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The adequate fraction is evaporated, the evaporation residue is treated at a pressure of 0.1 mm Hg, and the crystals are collected.

Thus, 1.6 g (57.1 %) of the title compound are obtained. M.p.: 71-72.5 °C.

^1H NMR (DMSO-d_6): δ 7.19 (2H, d, J=8.6 Hz), 6.98 (1H, s), 6.76 (2H, m), 6.65 (1H, m), 6.68 (1H, s), 6.57 (2H, d, J=8.6 Hz), 6.45 (1H, s), 6.13 (1H, s), 6.05 (1H, s), 5.74 (2H, bs), 3.70 (3H, s), 3.69 (3H, s), 2.65-2.40

(8H, m), 2.20 (3H, s), 2.13 (3H, d, J=1.0 Hz).

Example 54

5-(4-Aminophenyl)-7-[3-/N-benzyl-(2--morpholinoethylamino)/propionyl]-8-methyl--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

5.2 g (8.7 mmoles) of the compound prepared according to Example 42 are added to a mixture of 175 cm^3 of methanol and 35 cm^3 of water. To the mixture, 1.4 g of 10 palladium/carbon catalyst, and, in 10 minutes, 7.0 cm^3 (141 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 24 hours. Then, the catalyst is filtered, washed with methanol, and the filtrate is evaporated under reduced pressure. To the residue, 100 cm^3 of water and 150 cm^3 of dichloromethane are added. After 5 minutes' stirring, the phases are separated, and the aqueous phase is still twice extracted with 150 cm^3 of dichloromethane each time. The organic phase is dried, evaporated under reduced pressure, and the evaporation residue is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The appropriate fraction is evaporated, and the evaporation residue is crystallized from diisopropyl ether. The crystals obtained are filtered, and washed with diisopropyl ether.

Thus, 0.4 g (8.2 %) of the title compound are obtained (thin-layer chromatography: using a mixture of ethanol and ammonia in a ratio of 9:1, R_f = 0.75).
M.p.: 114-116 °C.
^{1}H NMR ($CDCl_3$): δ 7.31 (2H, d, J=8.7 Hz), 7.26 (5H, m), 6.72 (1H, s), 6.64 (2H, d, J=8.7 Hz), 6.62 (1H, s), 6.31 (1H, d, J=1.6 Hz), 6.05 (1H, d, J=1.6 Hz), 5.97 (1H, d, J=1.6 Hz), 3.98 (2H, s), 3.64 (6H, m), 2.93-2.68 (4H, m), 2.63 (2H, m), 2.44 (2H, m), 2.36 (4H, m), 2.25 (3H, s).

Example 55

5-(4-Aminophenyl)-8-methyl-7-/3-(2-morpholino-ethylamino)propionyl/-7H-1,3-dioxolo/4,5-h/-/2,3/benzodiazepine

When the compound prepared according to Example 42 is reduced by the method of Example 54, the debenzyl derivative of the compound according to Example 54 is also formed in the reaction. The two compounds are separated by the above column chromatographic method. The appropriate fraction is evaporated, and the evaporation residue is crystallized from diisopropyl ether. The crystals obtained are filtered, and washed with diisopropyl ether.

Thus, 0.7 g (16.9 %) of the title compound are obtained (thin-layer chromatography: using a mixture of ethanol and ammonia in a ratio

of 9:1, R_f = 0.65).
M.p.: 122-124 °C.
Analysis: for $C_{26}H_{31}N_5O_4$ (477.57)
calculated: N 14.66 %;
found: N 14.46 %.
^1H NMR ($CDCl_3$): δ 7.32 (2H, d, J=8.6 Hz), 6.67 (2H, s), 6.64 (2H, d, J=8.6 Hz), 6.32 (1H, d, J=1.1 Hz), 6.04 (1H, d, J=1.1 Hz), 5.97 (1H, d, J=1.1 Hz), 4.10 (2H, bs), 3.68 (4H, t, J=4.7 Hz), 3.2-2.5 (8H, m), 2.43 (4H, t, J=4.6 Hz), 2.27 (3H, d, J=1.1 Hz).

Example 56

5-(4-Aminophenyl)-8-methyl-7-[3-/4-(2-methoxyphenyl)piperazinyl/propionyl]-7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

10.2 g (17.9 mmoles) of the compound prepared according to Example 43 are added to a mixture of 300 cm^3 of ethanol and 60 cm^3 of water. To the mixture, 4.0 g of 10 % palladium/carbon catalyst, and, in 20 minutes, 20 cm^3 (404 mmoles) of 98 % hydrazine hydrate are added at 20-25 °C. The mixture is stirred at 25 °C for 24 hours. Then, the catalyst is filtered, and washed with ethanol. The filtrate is evaporated under reduced pressure. To the residue, 200 cm^3 of water are added. After an hour's stirring, the crystals are filtered, and washed with water. The crude product is transferred to a silica gel column that is eluted with a mixture of

chloroform and methanol. The appropriate fraction is evaporated, the evaporation residue is crystallized from diisopropyl ether. The crystals obtained are filtered, and washed with diisopropyl ether.

Thus, 1.15 g (11.9 %) of the title compound are obtained. M.p.: 190-194 °C. ^{1}H NMR ($CDCl_3$): δ 7.35 (2H, d, J(8.7 Hz). 7.1-6.8 (4H, m), 6.74 (1H, s), 6.73 (1H, s), 6.64 (2H, d, J=8,7 Hz), 6.32 (1H, d, J=1.2 Hz), 6.02 (1H, d, J=1.1 Hz), 5.93 (1H, d, J=1.1 Hz), 4.00 (2H, bs), 3.85 (3H, s), 3.07 (4H, m), 3.0-2.7 (4H, m), 2.69 (4H, m), 2.28 (3H, d, J=1.1 Hz).

Example 57

5-(4-Aminophenyl)-8-methyl-7-[3-/4-(3--methoxyphenyl)piperazinyl/propionyl]-7H--1,3-dioxolo/4,5-h//2,3/benzodiazepine

5.0 g (8.8 mmoles) of the compound prepared according to Example 44 are added to a mixture of 250 cm^3 of ethanol and 50 cm^3 of water. To the mixture, 1.5 g of 10 % palladium/carbon catalyst, and, in 10 minutes, 8 cm^3 (160 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 5 hours, then, the catalyst is filtered, washed with ethanol, and the filtrate is evaporated under reduced pressure. To the residue, 100 cm^3 of water are added. After an hour's stirring, the

crystals are filtered, and washed with water. The crude product is transferred to a silica gel column that is eluted with a mixture of hexane and acetone. The appropriate fraction is evaporated, and the evaporation residue is crystallized from diisopropyl ether. The crystals obtained are filtered, and washed with diisopropyl ether.

Thus, 2.9 g (61.2 %) of the title compound are obtained. M.p.: 105-106.5 °C.
Analysis: for $C_{31}H_{33}N_5O_4.H_2O$ (557.66)
calculated: C 66.76 %, H 6.33 %, N 12.56 %;
found: C 66.57 %, H 6.24 %, N 12.54 %.
^1H NMR ($CDCl_3$): δ 7.34 (2H, d, J=8.5 Hz), 7.14 (1H, t, J=8.1 Hz), 6.72 (1H, s), 6.71 (1H, s), 6.62 (2H, d, J=8.5 Hz), 6.51 (1H, dd, J=8.3 and 2.3 Hz), 6.44 (1H, t, J=2,3 Hz), 6.40 (1H, dd, J=8.0 and 2.3 Hz), 6.31 (1H, d, J=0.8 Hz), 6.00 (1H, d, J=1.2 Hz), 5.92 (1H, d, J=1.2 Hz), 4.04 (2H, s), 3.77 (3H, s), 3.14 (4H, t, J=4.8 Hz), 3.0-2.7 (4H, m), 2.61 (4H, t, J=4.8 Hz), 2.27 (3H, d, J=1.2 Hz).

Example 58

5-(4-Aminophenyl)-7-[3-/4-(4-fluorophenyl)--4-hydroxypiperidine-1-yl/propionyl]-8-methyl-7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

9.0 g (15.7 mmoles) of the compound prepared according to Example 45 are added to a mixture of 360 cm^3 of ethanol and 70

cm^3 of water. To the mixture, 3.6 g of 10 % palladium/carbon catalyst, and, in 20 minutes, 18 cm^3 (363 mmoles) of 98 % hydrazine hydrate are added at 20 to 25 °C. The mixture is stirred at 25 °C for 68 hours. Then, the catalyst is filtered, washed with ethanol, and the filtrate is evaporated under reduced pressure. To the residue, 200 cm^3 of water are added. After 2 hours' stirring, the crystals are filtered, and washed with water. The crude product is transferred to a silica gel column that is eluted with a mixture of hexane and acetone. The appropriate fraction is evaporated, and the evaporation residue is crystallized from diisopropyl ether. The crystals obtained are filtered, and washed with diisopropyl ether.

Thus, 3.47 g (40.87 %) of the title compound are obtained. M.p.: 130-132 °C.
Analysis: for $C_{31}H_{31}FN_4O_4$ (542.62)
calculated: C 68.62 %, H 5.76 %, N 10.33 %;
found: C 68.52 %, H 5.88 %, N 10.12 %.
^1H NMR (DMSO-d_6): δ 7.47 (2H, m), 7.21 (2H, d, J=8.6 Hz), 7.10 (2H, m), 6.99 (1H, s), 6.72 (1H, s), 6.59 (2H, d, J=8.6 Hz), 6.46 (1H, s), 6.14 (1H, s), 6.05 (1H, s), 5.71 (2H, s), 4.82 (1H, s), 2.67 (6H, m), 2.43 (2H, m), 2.16 (3H, s), 1.85 (2H, m), 1.57 (2H, m).

Example 59

5-(4-Aminophenyl)-7-(2-chloroacetyl)-8-methyl--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

4.0 g (10 mmoles) of the compound prepared according to Example 27 are transferred into 160 cm^3 of ethanol, 9.0 g (40 mmoles) of crystalline tin(II) chloride ($SnCl_2.2H_2O$) are added, and the mixture is boiled for 1.5 hours. After cooling, the reaction mixture is evaporated. To the residue, 120 cm^3 of water are added, and the mixture is extracted three times using 100 cm^3 of dichloromethane each time. The combined dichloromethane layers are washed twice with 30 cm^3 of 5 % aqueous sodium hydroxide solution each time, and twice with 150 cm^3 of water each time, then dried, and evaporated under reduced pressure. To the evaporation residue, 50 cm^3 of diisopropyl ether are added. After 30 minutes' stirring, the crystals are filtered.

Thus, 1.9 g (51.6 %) of the title compound are obtained. M.p.: 197-199 °C.

^1H NMR ($CDCl_3$ + DMSO-d_6): δ 7.27 (2H, d, J=8.6 Hz), 6.75 (1H, s), 6.72 (1H, s), 6.65 (2H, d, J=8.6 Hz), 6.35 (1H, s), 6.02 (2H, bs), 4.59 (2H, bs), 4.35 (2H, m), 2.25 (3H, d, J=1.0 Hz).

Example 60

5-(4-Aminophenyl)-7-(3-chloropropionyl)-8--methyl-7H-1,3-dioxolo/4,5-h//2,3/-benzodiazepine

6.18 g (15 mmoles) of the compound prepared according to Example 28 are transferred into 180 cm^3 of ethanol, 16.92 g (75 mmoles) of crystalline tin(II) chloride ($SnCl_2.2H_2O$) are added, and the mixture is boiled for 70 minutes. After cooling, the reaction mixture is evaporated under reduced pressure. To the residue, 200 cm^3 of water are added, and the pH of the solution is adjusted to 11 by the addition of 10 % aqueous sodium hydroxide solution. The mixture is extracted five times using 200 cm^3 of dichloromethane each time. The combined dichloromethane layers are washed twice with 250 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. To the evaporation residue, 100 cm^3 of diisopropyl ether are added. After 60 minutes' stirring, the crystals are filtered, and washed with diisopropyl ether. The crude product is recrystallized from ethanol.

Thus, 1.75 g (30.7 %) of the title compound are obtained. M.p.: 162-165 °C.

Analysis: for $C_{20}H_{18}ClN_3O_3$ (383.84)

calculated: N 10.95 %;

found: N 10.65 %.

^{1}H NMR ($CDCl_3$): δ 7.33 (2H, d, J=8.7 Hz), 6.73 (2H, s), 6.66 (2H, d, J=8.7 Hz), 6.33 (1H, d, J=1.3 Hz), 6.05 (1H, d, J=1.3 Hz), 5.98 (1H, d, J=1.3 Hz), 4.02 (2H, bs), 3.85 (1H, m), 3.75 (1H, m), 2.90 (1H, m), 2.27 (3H, d, J=1.3 Hz).

Example 61

5-(4-Aminophenyl)-8-methyl-7-methylcarbamoyl--7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine

4.0 g (10.5 mmoles) of the compound prepared according to Example 29 are transferred into 200 cm^3 of ethanol, 10.64 g (47.2 mmoles) of crystalline tin(II) chloride ($SnCl_2.2H_2O$) are added, and the mixture is boiled for 2 hours. After cooling, the reaction mixture is evaporated under reduced pressure. To the residue, 150 cm^3 of water are added, and the pH of the solution is adjusted to 11 by the addition of 10 % aqueous sodium hydroxide solution. The mixture is extracted three times using 300 cm^3 of dichloromethane each time. The combined dichloromethane layers are dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. To the evaporation residue, 30 cm^3 of diisopropyl ether are added. After 60 minutes' stirring, the crystals are filtered, and washed with diisopropyl ether.

Thus, 1.02 g (27.7 %) of the title compound are obtained. M.p.: 188-190 °C.

^{1}H NMR ($CDCl_3$): δ 7.27 (2H, d, J=8.6 Hz), 6.66 (1H, s), 6.65 (1H, s), 6.62 (2H, d, J=8.6 Hz), 6.13 (1H, d, J=1.0 Hz), 6.05 (1H, m), 6.00 (1H, s), 5.94 (1H, s), 3.7 (2H, bs), 2.92 (3H, d, J=5.0 Hz), 2.22 (3H, d, J=1.2 Hz).

Example 62

1-[2-/5-(4-Aminophenyl)-8-methyl-7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine-7-yl/-2-oxoethyl]pyrrolidine-2-one monohydrate

2.56 g (5.7 mmoles) of the compound prepared according to Example 35 are transferred into 100 cm^3 of methanol, 6.4 g (28.4 mmoles) of crystalline tin(II) chloride ($SnCl_2.2H_2O$) are added, and the mixture is boiled for 2 hours. After cooling, the reaction mixture is evaporated under reduced pressure. To the residue, 100 cm^3 of water are added, and the pH of the solution is adjusted to 11 by the addition of 10 % aqueous sodium hydroxide solution. The mixture is extracted three times using 300 cm^3 of dichloromethane each time. The combined dichloromethane phases are washed with 250 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. To the evaporation residue, 30 cm^3 of diethyl ether are added. After 60 minutes' stirring, the crystals are filtered, and washed with diethyl ether.

Thus, 2.14 g (85.9 %) of the title compound are obtained. M.p.: 103-105 °C. ^{1}H NMR ($CDCl_3$): δ 7.33 (2H, d, J=8.6 Hz), 6.73 (1H, s), 6.71 (1H, s), 6.63 (2H, d, J=8.6 Hz), 6.28 (1H, d, J=1.2 Hz), 6.04 (1H, bs), 5.98 (1H, bs), 4.57 (1H, d, J=17.0 Hz), 4.19 (1H, d, J=17.0 Hz), 3.99 (2H, bs), 3.49 (2H, t, J=7.2 Hz), 2.42 (2H, t, J=8.1 Hz), 2.26 (3H, s), 2.04 (2H, m).

Example 63

N-[2-/5-(4-Aminophenyl)-8-methyl-7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine-7-yl/-2-oxoethyl]phthalimide

4.02 g (7.9 mmoles) of the compound prepared according to Example 37 are transferred into 400 cm^3 of methanol, 8.9 g (39.4 mmoles) of crystalline tin(II) chloride ($SnCl_2.2H_2O$) are added, and the mixture is boiled for 72 hours. After cooling, the reaction mixture is evaporated under reduced pressure. To the residue, 200 cm^3 of water are added, and the pH of the solution is adjusted to 11 by the addition of 10 % aqueous sodium hydroxide solution. The mixture is extracted three times using 300 cm^3 of dichloromethane each time. The combined dichloromethane layers are washed twice using 250 cm^3 of water each time, dried over anhydrous magnesium sulfate, and evaporated under reduced pressure. To the evaporation

residue, 30 cm^3 of diethyl ether are added. After 60 minutes' stirring, the crystals are filtered, and washed with diethyl ether. The crude product is transferred to a silica gel column that is eluted with a mixture of hexane and acetone. The appropriate fraction is evaporated, and the residue is stirred in 30 cm^3 of diethyl ether for half an hour. The crystals obtained are filtered.

Thus, 1.52 g (40.2 %) of the title compound are obtained. M.p.: 189-191 °C. ^1H NMR ($CDCl_3$): δ 7.85 (2H, m), 7.70 (2H, m), 7.36 (2H, d, J=8.6 Hz), 6.77 (1H, s), 6.70 (1H, s), 6.66 (2H, d, J=8.6 Hz), 6.27 (1H, s), 6.04 (1H, s), 6.00 (1H, s), 5.06 (1H, d, J=16.1 Hz), 4.51 (1H, d, J=16.1 Hz), 3.9 (2H, br), 2.25 (3H, d, J=0.8 Hz).

Example 64

5-(4-Aminophenyl)-8-methyl-7-[2-/4-(3--methoxyphenyl)piperazinyl/acetyl]-7H-1,3-dioxolo/4,5-h//2,3/benzodiazepine dihydrate

4.0 g (7.2 mmoles) of the compound prepared according to Example 39 are transferred into 100 cm^3 of ethanol, 8.11 g (36 mmoles) of crystalline tin(II) chloride ($SnCl_2.2H_2O$) are added, and the mixture is boiled for 7.5 hours. After cooling, the reaction mixture is evaporated under reduced pressure. To the residue, 100 cm^3 of water are added, and the pH of the solution is

adjusted to 11 by the addition of 10 % aqueous sodium hydroxide solution. The mixture is extracted three times using 300 cm^3 of dichloromethane each time. The combined dichloromethane layers are dried, and evaporated under reduced pressure. To the evaporation residue, 30 cm^3 of diethyl ether are added. After 30 minutes' stirring, the crystals are filtered. The crude product is transferred to a silica gel column that is eluted with a mixture of chloroform and methanol. The appropriate fraction is evaporated, and the residue is stirred in 30 cm^3 of diethyl ether. The crystals obtained are filtered.

Thus, 0.25 g (6.6 %) of the title compound are obtained. M.p.: 148-150 °C.
Analysis: for $C_{30}H_{31}N_5O_4.2H_2O$ (561.64)
calculated: C 64.16 %, H 6.28 %, N 12.47 %;
found: C 64.66 %, H 6.56 %, N 12.33 %.
^1H NMR ($CDCl_3$): δ 7.32 (2H, d, J=8.7 Hz), 7.14 (1H, t, J=8.1 Hz), 6.73 (2H, s), 6.66 (2H, d, J=8.7 Hz), 6.51 (1H, dd, J=8.0 and 1.8 Hz), 6.42 (2H, m), 6.33 (1H, d, J=1.1 Hz), 6.03 (1H, s), 5.99 (1H, s), 3.99 (2H, bs), 3.78 (3H, s), 3.69 (1H, d, J=15.6 Hz), 3.37 (1H, d, J=15.6 Hz), 3.20 (4H, t, J=5.0 Hz), 2.74 (4H, m), 2.29 (3H, d, J=1.1 Hz).